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THE SUPREME COURT DECISION.

Elsewhere is given an abstract of the antagonistic opinions handed down last week from the United States Supreme Court in a case which easily takes first rank in the annals of patent litigation. Briefly, according to Chief Justice White, the opinion written by Justice Lurton finally fixes as the law of the land an extension of the patent monopoly which is practically without bounds. The chaotic condition of patent law is illustrated by the facility with which the prevailing and dissenting opinions of the court can each marshal precedents in support of their arguments. On the one hand, it has been held that "within his domain the patentee is czar. The people must take his invention on the terms he dictates or let it alone for seventeen years. Cries of restraint of trade and impairment of the freedom of sales are unavailing because, for the promotion of the useful arts, the constitution and statutes authorize this very monopoly." On the other hand, the late Justice Brewer said that "there is no peculiar sanctity hovering over or attached to the ownership of a patent"; courts have ruled that the patent laws do not give to inventors "the right to disregard laws enacted to promote the welfare of the whole people"; that "the property of an inventor in a patented machine, like all other property, remains subject to the paramount claims of society"; that the patent laws "do not authorize the patentee to employ his invention for a purpose or in a manner that may be forbidden to all other persons in the use of their unpatented property or discoveries." There have thus been two lines of judicial opinion on the nature of the patent monopoly, one liberal as regards the public interest and the other exactly the reverse. The vital effect of the recent Supreme Court decision is to suppress legally the former and—what is perhaps of greater importance—to command that all future opinions of lower federal courts shall be in conformity with the latter.

One naturally is curious as to the nature of the constitutional and statute authority which could lead to such a remarkable diversity of judicial opinion. This authority will be found extremely brief, consisting of a short clause in the constitution and a single statute law. The former reads as follows: "The Congress shall have power to promote the progress of science and useful arts by securing for limited tenure to authors and inventors the exclusive rights to their respective rights and inventions." The law passed by Congress to execute this provision is as follows, omitting the description of the form of specification: "Every patent shall contain . . . a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use and vend the invention or discovery throughout the United States." Upon these two sentences has been superposed a body of judge-made law

that fills volumes and which, from its conflicting nature, is little less than a disgrace to jurisprudence.

If, however, the line of decisions to which Judge Lurton has just added the finishing touch really worked in the interest of the bona fide inventor, one might question their reasonableness and yet acquiesce in their application. But in fact their effect is inimicable under present industrial conditions to the inventor as well as to the public. Under the law as now fixed by the Dick Supreme Court decision, it is possible by means of a few patents, or even a single patent, for an entire industry to become concentrated with a single interest or with a close combination of interests. Under such a condition the independent inventor, for whom the judges in their opinions express such a warm solicitude, would practically have no market for the product of his creative faculty. With the smaller manufacturer either wiped out of existence or so curbed as to cease being a factor in the development of an art, he could only look to the masters of the field. To these, however, the original inventor would become a real menace through threatening the rigorous standardization that would inevitably accompany the concentration of control of an industry. Of course, the Patent Office would still turn out its grist of patents, but these would consist of little more than "protective" patents, or patents covering improvements suggested by manufacturing or operating experience, which class of "inventions" requires a minimum of inventive skill and merely a simple salaried arrangement with those who turn them out. The situation the decision of Judge Lurton creates for the real inventor is thus a grave one, and it is sincerely to be hoped that Congress will at the earliest moment take some action for his relief. It should, however, not rest upon merely nullifying the Lurton decision, which action appears probable, but should also make provision for a thorough investigation of the existing patent system, either by the appointment of a joint congressional committee, as recommended by the Inventors' Guild or, better, by the appointment of a commission similar to that which recently investigated and reported on second-class mail rates.

AGAIN THE WATER-POWER TRUST.

The recent report to President Taft from the commissioner of corporations, abstracted elsewhere, again conjures up the bogy of the water-power trust forming, about to be formed, or in danger of being projected. We have already put ourselves on record at various times concerning the quite unnecessary amount of alarm produced by the tendency of hydroelectric plants in contiguous territory to unite forces and gain the advantages of physical consolidation. The commissioner of corporations, however, seems to go in the present report further into the matter than usual and is apparently greatly disturbed lest the available hydraulic powers should be concentrated in comparatively few hands and so made the subject of a general monopoly. The commissioner apparently does not fully grasp the idea that enterprises of the nature of central-station distributions, whether over a small territory or a large one, are in fact not advantageous subjects for an attempted maintenance of competition. It is very doubtful whether any community has gained anything by being served by two or three electric lighting and power companies simultaneously. Experience has shown that one organization well under public control does better than half a dozen fighting among themselves and not subject to effective public regulation. Any evils that might spring from the consolidation which the commissioner of corporations is worrying about can best be removed, not by more or less futile efforts at public ownership of hydraulic privileges, but by well-directed and systematic control of the public-service corporations that undertake to utilize these privileges. It is not a matter of great public importance whether, as the commissioner says, 60 per cent of the developed commercial water-power in the United States is owned by ten great groups of interests or by a hundred. If ten groups of financiers have been long-headed enough to see the advantages of water-powers and to develop them to the public good, it is certainly no subject for general alarm, unless there is so inefficient public regulation of such electrical supply corporations that they cannot be suitably kept in order. What this country needs is not legislation to prevent the development of its resources, but legislation to insure development in such a way as shall be a public benefit.

Public-service corporations undertaking work which is in its natural development monopolistic, as a well-ordered system of electrical supply over a large territory must be, are proper subjects for close governmental control, including the regulation of prices, so as to assure to the public in return for the virtual monopoly it has granted and the rights it has given, including often the right of eminent domain, fair and uniform treatment and moderate prices. It is in this direction that government regulation can work most effectively. It is all-important that the hydraulic privileges of the country be utilized promptly, and they will not be utilized promptly if a lot of over-enthusiastic alarmists make it increasingly difficult to acquire title to them. It is far more useful to the public to encourage their utilization at the earliest possible moment, but to see to it that no corporation undertaking the work is burdened with fictitious capital or by any other financial device enabled to wring an unfairly large profit out of the public. The thing to be feared is not the common ownership of many hydroelectric plants but the incidental stock-watering operations which may attend the consolidation of properties. In other words, nobody cares whether A., B., C. & Company own one water-power or forty, but it is of vital public interest that A., B., C. & Company should not be enabled by any device, however roundabout or ingenious, to consolidate forty water-powers at a fictitious capitalization which will enable them later to demand what may be in reality very much exaggerated profits.

It is not the physical or financial consolidation of plants that is to be feared in the least, but only the utilization of such things, like other valuable properties, for the purpose of grinding the public by over-capitalization. If the law cannot now reach these crooked operations, it should be so amended as to put it within the power of public-utility commissions and the like to hold down securities to actual development values so as to prevent that reckless capitalization of franchises and possible future earnings which has

been so dark a blot on American financiering. With hydraulic developments thus under public control, no one need worry about the actual ownership of any particular enterprise or group of enterprises. Let those who believe in water-powers and want to invest in them buy to their hearts' content, only with the distinct understanding that their investments are in public utilities subject to rigorous supervision.

THE NEW BOSTON POWER STATION.

In another column we describe at some little length the new and important alternating-current generating station of the Boston Elevated Railway Company. This company, as our readers will remember, until now consistently operated a group of auxiliary stations, each feeding into the common network at the ordinary working voltage of the trolley wires. This system of auxiliary stations has been remarkably well planned and has delivered energy to the working conductors at a singularly low cost—as low a cost probably as has been reached by most of the large alternating-current stations with their losses in the lines and in the synchronous converters. The time finally came, however, when the growth of the system made the distances to be covered inconveniently great, and it would have been necessary to build new auxiliary stations, if used, in locations where power generation could hardly be as cheap as in the existing locations; hence the great new station just built in South Boston, which is not intended to supersede all the existing stations by any means, but to operate with them. Opportunity, however, has been taken to shut down all of the smaller emergency or auxiliary stations which had grown up about the system, leaving in operation the more important and economical of the direct-current plants.

The new plant is close alongside of the generating station of the Boston Edison Company in South Boston and has an initial equipment rating of 30,000 kw, though it is designed to be pushed up to 125,000 kw if necessary. As readers of the descriptive article on another page will see, there is nothing at all sensational about the plant. It is simply a thoroughly well-designed modern equipment laid down along the lines which have become generally familiar in steam-turbine practice. As in many modern plants of the same general sort, the coal-handling equipment and the boiler-room are the most striking features, so to speak, of the equipment. The coal-handling devices in this particular instance are well worth study, as they are exceptionally elaborate and complete, and the same thoroughness of detail is carried into the auxiliary of the boiler-room, which is in most respects, even to the small comparative size of the boilers, entirely conventional. The switchboard and busbar departments, as is now common, are no unimportant portion of the power-house structure. Indeed, the modern turbine stations as laid out on the conventional plans almost involve a puzzling question of "Find the turbine," so completely are the actual generating units with their extraordinary compactness dwarfed by the enormous mass of accessory plant. That this should be so is a curious comment on the bulk efficiency of the turbine when one considers it without its auxiliaries. The effect of the new plant on the energy supplied to the system will unquestionably be very happy. There are six substations with synchronous converters placed at strategic points where power has been badly needed. Through these the South Boston plant will feed the outer suburban areas of the system, leaving the central portion of the city to be dealt with by the existing direct-current plants. This arrangement is particularly well adapted to take care of that wandering of the load which is so characteristic a feature of a great urban distribution, and it should now be possible, even more than ever before, to keep the auxiliary plants still in service at a very high load-factor.

VARIATION OF ILLUMINATIONS WITH HEIGHT OF SUSPENSION.

Of the fundamental photometric relations perhaps none is better known than the one connecting the illumination density with the candle-power of the source and the distance from the source. It is widely appreciated that the illumination in foot-candles is calculable by dividing the candle-power by the square of the distance in feet. Strange to say, the knowledge of this relation is apt to lead to erroneous conclusions when applied without taking other facts into consideration. With certain forms of lighting sources, the term "candle-power" can be applied only when so modified by explanation of the distance involved that it ceases to have any definite significance. For example, a point light source equipped with a parabolic reflector produces an "apparent candle-power" which varies directly with the square of the distance from the source, so that the illumination density is constant for all distances. It will be appreciated, therefore, that the so-called "inverse-square law" must be used with caution when calculating the density of illumination obtainable from lighting units equipped with reflectors.

In the present issue appears an article by Prof. W. E. Barrows in which it is shown that there are practical conditions under which the lighting density produced upon the floor of a room is approximately independent of the height of suspension of the lamps. This fact was discussed in detail in an article by Mr. A. A. Wohlauer in the *Electrical World* for March 21, 1908. The relations touched upon in these two articles are fundamental in that when reflection can be ignored the average illumination on a floor is equal in foot-candles to the total lumens directed toward the floor divided by the area of the floor in square feet. When the reflectors are so arranged that the amount of light directed toward the floor is not varied as the height of suspension is changed, then the average floor illumination is independent of the height of suspension. However, the uniformity in distribution of the light flux density will in general depend upon the height of suspension, the density being markedly non-uniform when the lamps are placed very low. In any case, the most convenient method known for determining the average illumination over any chosen surface is to divide the total number of lumens directed toward the surface by the area of the surface. When the average of the calculations made by other methods does not agree with the value of illumination density obtained by this method the calculations are known at once to be in error.

THE SUPREME COURT PATENT DECISION.

According to a report from Washington, the House committee on patents at a meeting on Friday of this week was to draw up a bill to meet the patent situation produced by Judge Lurton's Supreme Court decision last week in the Dick case. Members of the committee have stated that there will be legislation at this session and that it will be thorough. For some years a considerable number of bills for the reform of the patent system have been introduced at each session of Congress, but none has received any action. Before the recent Supreme Court decision no less than seventeen bills had been introduced in the House. Commenting on this situation, the New York *Journal of Commerce* says that at hearings of such bills "Congressmen sat and coldly listened to the arguments of those who desired to get some kind of remedy for a bad situation. Few persons have any doubt as to why no progress has been made with patent legislation. There have been many earnest patent reformers in Congress who made large promises, but their ardor was always dampened after a first attempt at legislation. After a little while they invariably begin to say that the subject is very large and technical, and that a man needs years to study it. The fact is that whenever one of these patent bills appears to get within gunshot range of enactment a powerful and active lobby is sent to Washington to see what can be done. Every influence is brought to bear to get the bills laid aside, and such efforts have been invariably successful. This is the general practice of all patent-protected interests when any reform legislation is sought. It will be as difficult as the revision of the tariff to get any satisfactory legislation on the subject adopted by Congress."

Referring also to the Congressional patent situation, the New York *Evening Post* says: "Two schools are likely to develop in Congress with respect to patent legislation. One will be represented, roughly speaking, by the extreme insurgent group, which would revoke patents or impose heavy penalties for any monopolistic use of a patented article. These would favor legislation directed against the 'tying' clauses. The other school would be representative of the 'interests,' who oppose any radical changes in the patent laws from purely selfish motives, and it would include a good many men having no selfish interest who sincerely believe that a patent is intended to create a monopoly for at least seventeen years, and who do not think that thousands of more or less successful inventions, a monopoly with which has caused no appreciable distress or injustice, should be endangered because the patent rights covering a few highly successful devices have been abused."

Nothing definite has been decided as to obtaining a rehearing of the Dick case. The attorney for the defendant has notified Attorney General Wickersham that his client will be glad to have the government appear by intervention if the case can be reopened. It is stated, however, that the rules of the court make difficult a reopening of the case, as such action must be requested by one of the judges who concurred in an opinion, and authorized by a majority of the court. In the present case the principle established in the decision was previously laid down by Justice Lurton in the button-fastener case, in which President Taft, then on the federal bench, concurred, and Justices Van Devanter and Holmes applied that principle in cases they decided when judges of lower federal courts.

The decision promises to give rise to numerous applications for reversal of decisions in patent cases where the decision did not conform to the principle established by the Supreme Court in the Dick case. Such an application has already been filed by a razor-making company which had been restrained from fixing a resale price for its patented razors.

The basis of the Dick suit has some unusual features. According to the record on appeal, "the defendant, Sidney Henry, sold to Miss Skou a can of ink suitable for use upon said mimeograph with knowledge of said license agreement and with the expectation that it should be used in connection with said mimeograph." It appears that Henry conducted a business, with his wife as partner, in office supplies and also sold a manifolding machine called the "lineograph," which to some extent competed with the Dick machine. Henry died in February, 1911, and the business of the firm is now being conducted by the widow at 112 Fulton Street, New York. Miss Skou, according to a newspaper interview with the attorney of Henry, was a detective engaged to make the purchase of a can of ink, which ink was not actually used on a mimeograph, and yet remains unopened. Moreover, a label on the container of ink sold by Henry, which is used for the lineograph and for stenciling, imposes the condition that the ink shall not be used on any licensed machine. This condition, it is stated, appears on the label of the can of ink sold to Miss Skou.

OPINIONS IN THE DICK CASE.

The opinions handed down last week by the United State Supreme Court in the case of the A. B. Dick Company are of unusual length. The prevailing opinion, written by Justice Lurton and concurred in by Justices Kenna, Holmes and Van Devanter, would occupy, if printed in full, about ten of these pages, and the dissenting opinion of Chief Justice White, which was concurred in by Justices Hughes and Lamar, would occupy about six pages. Much stress is laid by both papers on the opinion in the so-called button-fastener case, which strongly set forth the unrestricted nature of the patent monoply. The opinion in that case was also written by Justice Lurton when he was on the bench of a lower federal court, and it was concurred in by President Taft, then a federal judge. Justice Lurton quotes in support of his arguments from opinions of Justices Van Devanter and Holmes rendered from lower federal benches.

The case came before the court on a certificate from the United States Circuit Court of Appeals for the Second District of the Second Circuit. The opinion in favor of the Dick Company in that court was rendered by Justice Ray.

PREVAILING OPINION.

In opening the opinion Justice Lurton states that the facts and questions certified in the Dick case to the Supreme Court were as follows:

"This action was brought by the complainant, an Illinois corporation, for the infringement of two letters patent owned by the complainant, covering a stencil-duplicating machine known as the 'rotary mimeograph.' The defendants are doing business as co-partners in the city of New York. The complainant sold to one Christina B. Skou, of New York, a rotary mimeograph embodying the invention described and claimed in said patents under license which was attached to said machine, as follows:

" 'This machine is sold by the A. B. Dick Company with the license restriction that it may be used only with the stencil paper, ink and other supplies made by the A. B. Dick Company, Chicago, U. S. A.'

"The defendant, Sidney Henry, sold to Miss Skou a can of ink suitable for use upon said mimeograph with knowledge of the said license agreement, and with the expectation that it would be used in connection with said mimeograph. The ink sold to Miss Skou was not covered by the claims of said patent.

"Upon the facts above set forth the question concerning which this court desires the instructions of the Supreme Court, is, 'Did the acts of the defendants constitute contributory infringement of the complainant's patents?' "

The opinion states that the counsel for Henry fully concedes that a patentee may effectually restrict the time, place or manner of using a patented machine, and that a pro-

hibited use would constitute an infringement of the patent. The contention is not that a patentee may not permit the use of a patented thing with such qualifications as he sees fit to impose, and that a prohibited use will be an infringing one, but that he can keep the article within the control of the patent only by retaining the title.

"To put the contention in another form—it is that any transfer of the patentee's property right in a patented machine carries with it the right to use the entire invention so long as the identity of the machine is preserved, irrespective of any restrictions placed by the patentee upon the use of the article and accepted by the buyer. It is said that by such a sale the patentee 'disposes of all his rights under his patent, and thereby removes the article from the operation of the patent law.' If he attempts to sell a machine for specific uses only and prohibits all others, the restriction is disposed of as constituting a collateral agreement such as any vender of personal property might impose, and enforceable, if valid at all, only as a collateral contract."

The opinion then asked, "But is it true that where a patentee sells his patented machine for specific and limited use he does not thereby reserve to himself, as patentee, the exclusive right of all unpermitted uses which may be made of his invention as embodied in the machine sold?" The conclusion is that this is a question arising under the patent law, and not one of collateral contract enforceable by the usual processes of law.

After quoting a number of cases, the opinion states that the argument for the defense ignores the distinction between the property right in the materials composing a patented machine and the right to use for the purpose and in the manner pointed out by the patentee, which latter may be and often is the greater element of value, and the buyer may desire it only to apply to some or all of the uses included in the invention.

Judge Ray, who decided the present case in the Circuit Court, is quoted to the effect "that the patentee sold his machines at cost or less, and depended upon the profit realized from the sale of other non-patented articles adapted to be used with the machine." Commenting upon this, Judge Lurton states that such a sale, while transferring the property right in the machine, carries with it only the right to use it for practising the invention according to the terms of the license, and to no other or greater extent does the patentee consent to the use of the machine. When the purchaser is sued for infringement by using the devices, he may defend by pleading, not the general and unlimited license which is carried by an unconditional sale, but the limited license indicated by the metal tablet annexed to the machine. If the use is not one permitted, it is plainly an infringing use.

Judge Lurton quotes from his opinion in the button-fastener case to the effect that "a patentee, if he sees fit, may reserve to himself the exclusive use of his invention or discovery. If he will neither use his device nor permit others to use it, he has but suppressed his own. That the grant is made upon the reasonable expectation that he will either put his invention to practical use or permit others to avail themselves of it upon reasonable terms is doubtless true. * * * A suppression cannot endure but for the life of a patent, and the disclosures which he has made will enable all to enjoy the fruit of his genius. His title is exclusive, and so clearly within the constitutional provisions in respect to private property that he is neither bound to use his discovery himself nor permit others to use it."

A quotation is made from an opinion in another case, to the effect that the very object of patent law is monopoly, and the rule is, with few exceptions, that any conditions which are not in their very nature illegal with regard to this kind of property, imposed by the patentee and agreed to by the licensee for the right to manufacture or use or sell the article, will be upheld by the courts. The fact that conditions in the contracts keep up the monopoly or fix prices does not render them illegal. Further on the opinion states that if a patentee says, "I may suppress my patent if I will; I may make and have made devices under my patent, but I will neither sell nor permit any one to use the patented things," he is within his right, and none can complain. But if he should say that he will sell only upon the condition of using only such articles as are made by him in connection with the invention, "if he chooses to take his profit in this way instead of taking it by a higher price for the machines, has he exceeded his exclusive right to make, sell or use his patented machines? The market for the sale of such articles to the users of his machines, which by such a condition he takes to himself, was a market which he alone created by the making and selling of a new invention. Had he kept his invention to himself no supplies could have been sold by others for use upon machines embodying that invention. By selling it subject to the restriction he took nothing from others and in nowise restricted their legitimate market." Further on it is stated that the public by permitting the invention to go unused loses nothing which it had before, and when the patent expires will be free to use the invention without compensation or restriction. "We are not at liberty to say that the Constitution has unwisely provided for granting a monopolistic right to inventors, or that Congress has unwisely failed to impose limitations upon the inventor's exclusive right of use. And if it be that the ingenuity of patentees in devising ways in which to reap the benefit of their discoveries requires to be restrained, Congress alone has the power to determine what restraints shall be imposed. As the law now stands it contains none, and the duty which rests upon this and upon every other court is to expound the law as it is written. Arguments based upon suggestions of public policy not recognized in the patent law are not relevant. The field to which we are invited by such arguments is legislative and not judicial."

The conclusion of the court is that there is no difference in principle between a sale subject to specific restrictions as to time, place or purpose of use and restrictions requiring a use only with other things necessary to the use of the patented article purchased from the patentee. "If the violation of the one kind is an infringement, the other is also. That a violation of any such restriction annexed to a sale by one with notice constitutes an infringing use has been decided by a great majority of the circuit courts and circuit courts of appeal and has come to be a well-recognized principle in the patent law, in accordance with which vast transactions in respect to patented articles have been conducted, and should at least not be overruled except upon reasons so clear as to make any other construction of the patent law inadmissible."

A number of cases are then quoted in support of the position that the trend of judicial opinion is that license restrictions annexed to patented articles, when sold, constitute licenses under the patent, and that their violation by persons having notice constitutes an infringement of the patent acts. An opinion of Judge Van Devanter is quoted in which it is stated that the patent monopoly "is a final property right conferred by law as an inducement or stimulus to useful invention or discovery, and that it rests with the owner to say what part of the property he will reserve to himself and what part he will transfer to others and upon what terms he will make the transfer." The opinion of Justice Holmes is quoted to sustain the argument that there is no collision between the rule against restrictions upon the alienation or use of chattels not made under the protection of a patent and the right of the patentee through his control over his invention. A number of English patent cases are also quoted in support of the argument that a patentee can impose restrictions to the use of his invention, provided that such conditions are clearly brought home to the purchaser at the time of sale.

A decision is considered at some length in regard to restrictions imposed as to the resale price of books. Certain publishers had attempted to fix the price at which a copyrighted book might be sold by retailers by printing in the book a notice that it could not be sold for less than a prescribed price. Some department stores refused to accept this restriction and the Supreme Court upheld them. Justice Lurton did not consider, however, that there is any analogy between the right of one under the copyright statute to fix the price at which a copyrighted book might be sold by retailers by a mere notice accompanying the book, and the right of one selling a patented article subject to a condition that it should not be sold at less than the prescribed minimum price. Judge Lurton quoted from his opinion in the button-fastener case as follows: "There is a wide difference between the right of multiplying and vending copies of a production protected by the copyright statute and the rights secured to an inventor under the patent statutes." The opinion states that Congress provides that an author should have the sole liberty of "printing, reprinting, publishing, completing, copying, executing, finishing and vending" his articles. On the other hand, to the inventor is granted "the exclusive right to make, *use* and vend the invention or discovery." This latter grant is stated to "consist altogether in the right to exclude every one from making, *using* or vending the thing patented. * * * The questions of property rights sought to be guaranteed and the terms of the two statutes are, the opinion states, so different that very different constructions have been placed upon them. There is no collision whatever between the decisions in the copyright case and the present opinion."

The conclusion of the opinion is that the acts of the defendants constitute contributory infringement of the complainant's patent. "Undoubtedly a bare supposition that by a sale of an article which though adapted to an infringing use is also adapted to other and lawful uses, is not enough to make the seller a contributory infringer. Such a rule would block the wheels of commerce. There must be an intent and purpose that the article sold will be so used." It is added that in this case it is not open to the defense to say that the ink sold might be used in a non-infringing way, for the certified fact is that they made the sale "with the expectation that it would be used in connection with said mimeograph."

DISSENTING OPINION.

The opinion of Chief Justice White opens as follows: "My reluctance to dissent is overcome in this case: First, because the ruling now made has a much wider scope than the mere interest of the parties to this record, since, in my opinion, the effect of that ruling is to destroy, in a very large measure, the judicial authority of the states by unwarrantedly extending the federal judicial power. Second, because the result just stated, by the inevitable development of the principle announced, may not be confined to sporadic or isolated cases, but will be as broad as society itself, affecting a multitude of people and capable of operation upon every conceivable subject of human contract, interest or activity, however intensely local and exclusively within state authority they otherwise might be. Third, because the gravity of the consequences which would ordinarily arise from such a result is greatly aggravated by the ruling now made, since that ruling not only vastly extends the federal judicial power, as above stated, but as to all the innumerable subjects to which the ruling may be made to apply, makes it the duty of the courts of the United States to test the rights and obligations of the parties, not by the general law of the land, in accord with the conformity act, but by the provisions of the patent law, even although the subjects considered may not be within the embrace of that law, thus disregarding the state law, overthrowing, it may be, the settled public policy of the state, and injuriously affecting a multitude of persons. Lastly, I am led to express the reasons which constrain me to dissent because of the hope that if my forebodings as to the evil consequences to result from the application of the construction now given to the patent statute be well founded, the statement of my reasons may serve a twofold purpose: First, to suggest that the application in future cases of the construction now given be confined within the narrowest limits, and, second, to serve to make it clear that if evils arise their continuance will not be caused by the interpretation now given to the statute, but will result from the inaction of the legislative department in failing to amend the statute so as to avoid such evils.

"Let me briefly recapitulate the facts and the rulings based thereon. A machine styled a rotary mimeograph was covered by a patent. The claims of the patent, however, did not embrace the ink or other materials used in working the machine, nor were they covered by independent patents. The Dick Company, owner of the patent, sold one of the machines to a Miss Skou. The entire title was parted with; in other words, there was no condition imposed affecting the title or the uses to which the machine might be applied or the duration of the use. Upon the machine, however, was inscribed a notice, styled a license restriction, reciting that the machine 'may be used only with the stencil paper, ink and other supplies made by the A. B. Dick Company, Chicago, U. S. A.' The Henry Company, dealers in ink, sold to Miss Skou, for use in working her machine, ink not made by the Dick Company. The court now decides that a use of such ink by Miss Skou would have been 'a use of the machine in a prohibitive way,' and would have rendered her 'liable to an action under the patent law for infringement,' and that the seller of the ink was liable as an infringer of the patent on the machine because of the aiding and abetting a proposed infringing use.

"I cannot bring my mind to assent to the conclusion referred to, and shall state in the light of reason and authority why I cannot do so. As I have said, the ink was not covered by the patent; indeed, it is stated in argument and not denied that a prior patent which covered the ink had expired before the sale in question. It, therefore, results that a claim for the ink could not have been lawfully embraced in the patent, and if it had been by inadvertence allowed such claim would not have been enforceable. This curious anomaly then results that that which was not embraced by the patent, which could not have been embraced therein, and which if mistakenly allowed and included in an express claim would have been inefficacious, is now by the effect of a contract held to be embraced by the patent and covered by the patent law. This inevitably causes the contentions now upheld to come to this, that a patentee in selling the machine covered by his patent has power by contract to extend the patent so as to cause it to embrace things which it does not include; in other words, to exercise legislative power of a far-reaching and dangerous character. Looking at it from another point of view and testing the contention by a consideration of the rights protected by the patent law and the rights which an inventor who obtains a patent takes under that law, the proposition reduces itself to the same conclusion. The natural right of anyone to make, vend and use his invention which but for the patent law might be invaded by others is by that law made exclusive, and hence the power is conferred to exclude others from making, using or vending the patented invention."

The opinion proceeds to say that the patent involved in the mimeograph was not concerned in any way with the materials to be used in operating the machine, and certainly the right protected by the patent was not the right for any particular ink or other operative materials. Every use, he said, which the patent protected was transferred to Miss Skou, and the very existence of the particular restriction under consideration presupposes such right of complete enjoyment, and because of this postion there was engrafted a contract restriction, not upon the use of the machine, but upon the materials. By the act of selling a patented

machine, and thus disposing of all of the uses of which it is capable, a patentee is endowed with the power to amplify his patent by causing it to cover in the future things which at the time of sale it did not embrace, thus virtually legislating by causing the patent laws to cover subjects which, without the exercise of the right of contract, they could not reach. The result of this is not only to multiply monopolies at the will of an interested party, but also to destroy the jurisdiction of the state courts over subjects which from the beginning have been within their authority. "The ruling now announced endows the patentee with the right by contract not only to produce a fundamental change as to the jurisdiction of the state and federal courts, but also to bring about the overthrow of the public policy both of the state and the nation."

The opinion gives a number of illustrations as to the effect of the decision. Taking the case of a patented window-frame, it is stated that "it is now the law that the seller of the frame may stipulate that no other materials shall be used in the house in which the window-frames are placed except such as made by the patentee or seller of the frame." Referring to a case decided some years ago by one of the circuit courts of appeal (reference apparently being made to the decision of Judge Lurton in the button-fastener case in a lower court), it is stated that what previously was designated a condition of sale, governed by the general principles of law, has come in practice to be denominated a license restriction, thus, by the change of form in the doctrine referred to, bringing the matters covered by the restriction within the exclusive sway of the patent law. It is, the opinion states, a matter of common knowledge that the change has been frequently resorted to for the purpose of bringing numerous articles of common use within the monopoly of a patent when otherwise they would not have been embraced therein, thereby tending to subject the whole of society to a widespread and irksome monopolistic control. A number of court opinions are adduced to refute the existence of a supposed right of extension by contract of the patent laws. One of these opinions, which is said to touch upon the precise question before the court, is as follows: "One who buys patented articles of manufacture from one authorized to sell them becomes possessed of an absolute property in such article, unrestricted in time or place. Whether the patentee may protect himself and his assigns by special contracts brought home to the purchaser is not a question before us, and upon this we express no opinion. *It is, however, obvious that such a question would arise as a question of contract, and not as one under the inherent meaning and effect of the patent laws.*"

Another opinion is quoted as follows: "The first defense rests on the question whether when a machine is designed to manufacture, distribute or serve out to users a certain article, the article so dealt with can be said to be a part of the combination of which the machine itself is another part. If this be so, then it would seem to follow that the log which is sawn in the mill, the wheat which is ground by the rollers, the pin which is produced by the patented machine and the paper which is folded and delivered by the printing press may be claimed to be an element of the combination of which the mechanism doing the work is another element. The motion of the hand necessary to turn the roll and withdraw the paper is analogous to the motive power which operates the machine in the other instances."

Justice White says that within the limits of his powers of understanding, looking at the so-called license restriction again with the purpose, if possible, to bring his mind to assent to the view which the court takes of it, he finds it impossible to do so, adding that in this connection the real nature of the transaction is, in the argument of counsel for the Dick company, stated to be directly the opposite of that which the court now holds it to be.

Referring to an English decision quoted in the prevailing opinion, Justice White says that he passes by these decisions with the remark that it is not perceived how they can have any persuasive effect on the suit in hand, in view of the distinction between state and national power which here prevails, and the consequent necessity, if our institutions are to be preserved, of forbidding a use of the patent laws which serves to destroy the lawful authority of the states and their public policy. He also fails to see the application of the English cases in view of the possible difference between the public policy of Great Britain, irrespective of the patent law, to make contracts with the monopolistic restriction which the one here recognized embodies, and the public policy of the United States on this subject as established, after great consideration, by the Supreme Court in a leading case. Taking up the various decisions of the circuit courts of appeal to which the prevailing opinion refers, Justice White says that, as they conflict with the many adjudications of the Supreme Court, it seems to him that they ought not to be followed, but should be overruled. It is undoubted, he says, that the leading one of the cases which all of the others but follow and reiterate is the button-fastener case, the theory of which, he adds, is in absolute conflict with many adjudications of the Supreme Court. "The button-fastener case and the confusion which has followed the application of the ruling made in that case were but the consequence of failing to observe the difference between the rights of a patentee which were protected by the patent, and those which arose from contract, and therefore were subject alone to the general law. In addition, it may be well to observe that the very groundwork upon which the case proceeded has been since authoritatively declared by this court to be without foundation. For instance, it will become apparent from an analysis of the opinion in the case that it proceeded upon the theory that the doctrine upheld had been virtually sanctioned in previous adjudications of this court." It is added, however, that the decision of the court in the copyright case above referred to has expressly declared that the doctrine had never been upheld by the Supreme Court. Moreover, in the copyright case, the Supreme Court expressly pointed out that the case had been misconceived in the opinion in the button-fastener case and did not have the significance which had there been attributed to it.

Justice White said that since the decision in the button-fastener case the attempt to increase the scope of the monopoly granted by a patent has become common by resorting to the device of license restrictions manifested in various forms, all of which tend to increase monopoly and to burden the public in the exercise of their common rights. "My mind cannot shake off the dread of the vast extension of such practices which must come from the decision of the court now rendered. Who, I submit, can put a limit upon the extent of monopoly and wrongful restriction which will arise, especially if by such a power a contract which otherwise would be void as against public policy may be successfully maintained?

"What could more cogently serve to point to the reality and conclusiveness of these suggestions than do the facts of this case? It is admitted that the use of the ink to work the patented machine was not embraced in the patent, and yet it is now held that by contract the use of materials not acquired from a designated source has become an infringement of the patent, and exactly the same law is applied as though the patent in express terms covered the use of ink and other operative materials. It is not, as I understand it, denied, and if it were, in the face of the decision in the Miles Medical Company case, in reason it cannot be denied that the particular contract which operates this result if tested by the general law would be void as against public policy. The contract, therefore, can only be maintained upon the assumption that the patent law and the issue of a patent is the generating source of an authority to contract to procure rights under the patent law not otherwise within

that law, and which could not be enjoyed under the general law of the land. But here, as upon the main features of the case, it seems to me this court has spoken so authoritatively as to leave no room for such a view. In Pope Manufacturing Company v. Gormully, 144 U. S. 224, the validity of certain stipulations contained in a license to use patented inventions came under consideration. It was decided that contracts of that character, like all others, were to be measured by the law of the land and were non-enforceable if they were contrary to general rules of public policy. And it was further held that even if contracts of that character were not void as against general principles of public policy, the aid of a court of equity would not be given to their enforcement if the stipulations were unconscionable and oppressive, as are, in my judgment, aside from the rule of public policy, the stipulations of the contract here involved.

"Indeed, when the decree rendered by the lower court which is now affirmed is considered, it seems to me the conclusion cannot be escaped that, although in the mental process by which it was held that relief under the patent law could be afforded the contract was treated as a restriction upon the use of the machine covered by the patent, so inexorable was the contrary result of the contract that in framing the decree it became necessary to give relief upon the theory that the gravamen of the suit was the violation of a contract stipulation in regard to unpatented materials."

HISTORY OF MIMEOGRAPH PATENTS.

The decision of the United States Supreme Court in the case of the A. B. Dick Company directs attention to the manner in which, under the present patent system, a patent monopoly may be continued almost indefinitely. The original mimeograph patent was granted to Thomas A. Edison in 1876, and thus expired in 1893. In 1880 a patent was granted to Mr. Edison for making a special kind of stencil sheet for the mimeograph, the term of which ended in 1897. In 1888 Broderick obtained a patent, assigned to the Dick Company, on another kind of stencil paper, which patent expired in 1905. In 1890 the Dick Company secured a patent on an ink for use with the mimeograph, which expired in 1907. In 1903 and 1904 patents were obtained on a movable stop for fixing the position of the mimeograph paper, on the strength of which the suit just ended was instituted.

Referring to the latter patents, the brief of the defendants in the Supreme Court suit says: "They both refer to a mere detail of a movable stop for fixing the position of the paper, *** and it is because the complainant owns these patents on these small details, built upon a monopoly previously enjoyed by it under the Edison, the Broderick, the Fuerth and other patents for machinery, stencil paper and ink, that it makes bold to assume that it still has the right to claim that the sale of ink on the part of any person who expects that ink to be used on a machine having such a stop pin for defining the position or location of the sheet of paper constitutes an infringement of these latest patents."

WATER-POWER DEVELOPMENT IN THE UNITED STATES.

Under date of March 14 Mr. Herbert Knox Smith, commissioner of corporations, transmitted to President Taft his report on "Water-Power Development in the United States," which covers a very exhaustive investigation into the whole water-power situation. In his letter of submittal Commissioner Smith points out that water-power in general, once of purely local value and application, has now, through electrical transmission, been brought to a market of great area and thus falls within the sweep of large economic forces. The results brought out by the investigation are stated as follows:

(1) An increasing concentration of the control of water-powers by certain large interests.

(2) Extensive relationship between water-power interests, public-service companies (street-railway, lighting and power concerns) and banks.

(3) The need of developing our water-powers as promptly and completely as practicable. Use of water-power means conservation of fuel.

(4) The need for a definite public policy with respect to water-powers. The effective means of applying such policy is through the control of the power site. It cannot be applied through fixing the price of water-power independently of fuel power.

The total stationary power development in the United States from steam, water and gas sources is estimated as probably over 30,000,000 hp, which includes about 6,000,000 hp from water-power. Developments less than 1000 hp were not considered, and the total amount of those exceeding this figure is about 4,000,000 hp, of which three-fourths is produced for sale. Our water-power now economically capable of development, the report states, probably does not exceed 25,000,000 hp, including that already developed. The total developed and undeveloped is mainly in the far Western states, the lake states and certain Atlantic seaboard states. Water-power now in use, it is estimated, saves at least 33,000,000 tons of coal annually.

TRANSFORMER PATENT LITIGATION.

Two interesting opinions in cases involving transformer patents have recently been rendered in Pennsylvania federal courts. One involves a detail improvement to the transformer, and the other relates to the Stanley patent, which has figured so largely in patent suits. In each case the decision was adverse to the owners of the patents.

One case related to a patent granted Aug. 26, 1906, to Walter A. Hall and assigned to the General Electric Company, on an application filed May 12, 1904, which claimed a means for transformer ventilation, the coils being made in separable shells or layers eccentric to each other when placed on the cores. The lower court decided against the patentability of this construction, and on appeal Judge Buffington at Philadelphia upheld this decision, declaring that only an engineering improvement is described and claimed, there being an absence of any and all of those features which ordinarily betoken invention. A study of the testimony, he said, shows that Hall's device was simply the thoughtful work of a trained electrical engineer, who, when directed by his superior officer "to investigate to see what economies might be introduced as a result of modifying our practice so as to use internal ducts in transformers of sizes of, say, 25 kw to 30 kw," did so; or, to quote the words of that officer: "One of my assistants, W. A. Hall, by name, was given the problem to investigate. After considerable study he submitted designs and finally built a model along the lines that I have just described. The design was so much more efficient and cost so much less money than what he had previously used that it was adopted and embodied in our regular production some time in the latter part of the year 1902."

The court says that the only novelty claimed by Hall in his patent was in substituting eccentric for concentric coil mounting, and the only advantage therein alleged was in economy of construction and that, instead of "being located concentrically, as heretofore, the two outer coils are arranged so that a wider ventilating space is formed at one side of the core than at the other. * * * The case, then,

narrows down to the question whether the substitution in a transformer of eccentric for concentric coil mounting involved invention. In view of the fact that the general principles and practice of ventilating spaces in transformers were well known, as was the desirability of keeping the transformer coils close together within the magnetic circuit for electrical advantages and of separating them outside the circuit for ventilating purposes, we cannot regard Hall's eccentric coil mounting as other than simply an economical improvement designed by an engineer skilled in that highly developed art."

The second case related to the widely known Stanley transformer patent, granted March 1, 1892, to William Stanley on an application filed Aug. 15, 1888, and assigned to the Westinghouse Company. This patent expired in 1909, but was brought to a final hearing before Judge Orr at Pittsburgh on claims for pay for infringement.

The Stanley patent has figured largely in litigation, and the point upon which stress was laid was a so-called rule for proportioning the length of windings. In the Saranac Lake case Judge Cox, of the Second District, held that Stanley had discovered he could "remedy existing evils by regulating the length of the wire on the primary coil of the transformer," adding that: "To the uninitiated Stanley's rule seems indefinite and obscure, but electricians have no difficulty in understanding it." In the same case, on appeal, Judge Lacombe decided that the patent, recognizing the various elements involved, "gives a rule applicable to all conditions." In another case in which the Stanley Transformer Company was defendant, Judge Colt, of the First District, refused an injunction on the ground that the defendants' apparatus was not made by the Stanley rule. Subsequently, in the first district and circuit, both Judges Cox and Townsend held, in the case of the Montgomery Electric Light & Power Company, that the controlling element was the length of wire on the primary coil, and not the instrument or method by which that length is determined.

In his opinion, delivered in Pittsburgh, Judge Orr said it was insisted by the plaintiff that he was bound by the construction given to the patent by the courts of the second circuit. In commenting on this contention he said that "if the phenomena of electricity and its laws had ceased to be in dispute at the date of the patent, if the art were not obscure to those most intimate with it, there would be great force in the position that this court for reasons of comity should adopt the conclusions reached elsewhere. It may well be doubted," he added, "that any court to-day would reach the same conclusions under the evidence offered in this case." Since, however, the patent had expired and an injunction was not sought, and because the fact of infringement was not found, Judge Orr said that the question of validity of the patent need not enter into the case.

Referring to the evidence introduced by both sides, the court said that this was great in bulk, most of it being expert testimony of a technical and scientific character, and that hypothetical questions were answered by experts of perhaps equal qualifications in very different ways. Repeated study of the propositions urged on the part of the plaintiff had, however, failed to convince him that they have sufficient merit to justify a finding for such plaintiff. "It was not made to appear satisfactorily that defendants use the Stanley rule in the construction of their transformers. Experiments were made by plaintiff's experts as well as by defendants' experts and were confidently relied upon as settling the question. The former were not made by the use of different lengths of primary wire, but were made by the use of a uniform length of wire and by repeatedly changed and increased voltage. The latter were made with varied lengths of primary wire and by uniform applied voltages. The former observed a difference between the counter and applied potentials, while the latter did not." The court added that the evidence in respect to the latter is more satisfactory and, when considered with the offer of the defendants to repeat their experiments in the presence of representatives of plaintiff and their declination of such offer, should be considered as convincing. The conclusion, he said, seems to follow that defendants' transformer is self-regulating without respect to the number of turns of primary wire. "If defendants' length of primary wire be not ascertained by the Stanley rule, or be not such as would be arrived at by the use of the rule, then under the decisions above cited infringement cannot be found."

There are two general types of transformers, the court said, called the core type and the shell type. "In the former the coils mainly surround the iron, in the latter the iron mainly surrounds the coils. Defendants' transformer is of the former type. All transformers which were the subject of former litigation with respect to the Stanley patent, so far as appears, were of the latter type. The plaintiff has not satisfied the court that there may not be a different magnetic relation between coils and core in the one from that in the other, or a difference between the electrical or magnetic conditions in each. Hypothesis without test does not answer."

In conclusion Judge Orr said that the case was one where the absence of actual fact proof was not met by expert speculations, that the plaintiff had not sustained the burden which rested upon it, and that its evidence of infringement by defendants was not sufficient.

VENTILATION OF RAILWAY TUNNEL BY OZONATED AIR.

During the past eleven years the Central London Railway Company has been ventilating its 13-mile tunnel according to the exhaust system. The method employed consisted in closing all of the doors underground for a certain period after the running of the last train and drawing the air through the tube from one end to the other by means of a 200-hp exhaust fan. This method of ventilation has recently been altered, so that at the present time the air is continuously refreshed by the introduction of ozone at each station along the road.

The ventilating equipment consists of a separate independent plant at each station, with the exception of Shepherd Bush station, which is near the open end of the tunnnel. Use is made of a filter screen, which cleans and washes the incoming air from all dirt and smuts and at the same time absorbs such gases as ammonia and sulphuric acid. An electric motor is used for drawing the air through the filter screen, which is kept moistened by means of a continuous flow of water from a series of jets at its upper edge.

The ozone generator consists of a series of ten generating units, each comprising a thin mica plate with a sheet of metallic gauze on either side. The set of ten plates is mounted on insulating supports. The gauze sheets are connected across the secondary terminals of the transformer, by which they are subjected to a difference of alternating emf of several thousand volts. In this way a large number of minute discharges occur over all of the opposing surfaces of the plates. The electrical discharge produces ozone, which is conveyed to a mixing chamber, through which air is forced by a main ventilating fan, and thence blown down the main air trunk to the various distributing sheet-metal ducts or conduits and eventually delivered to those places where it is required.

Each of the equipments is arranged to provide about 360,000 cu. ft. of air per hour. The main ventilating fans are driven by 7.5-hp motors. The ozone generators, which were built by the firm Ozonair, Ltd., are supplied with energy at 5000 volts from a transformer fed at 380 volts from a small 550-volt synchronous converter operated inverted.

COOPER HEWITT CONVERTER FOR RAILWAY SERVICE.

After a series of experiments extending over eight years, Dr. Peter Cooper Hewitt has succeeded in developing a mercury-vapor converter capable of delivering energy at a sufficiently high rate to operate railway cars or perform similar service. In its fundamental principle of operation the latest type of converter does not differ from the earlier types which have been in service for many years for smaller outputs. However, the constructive features have been radically altered in order to overcome certain limitations in output encountered in the earlier equipments. The significance of the improvements will be appreciated from the fact that formerly about 50 amp was considered the limiting output, while with the newest equipment an output of over 700 amp has already been reached.

The theory of the operation of the mercury-vapor converter as developed by Dr. Hewitt is well known. On Jan. 3, 1902, he presented before the American Institute of Electrical Engineers a paper in which he attributed the difficulty in starting an arc through mercury vapor to an initial negative electrode resistance which must be overcome before an appreciable current can be produced. It was on Jan. 17, 1903, that the announcement of the polyphase converter was first made in these columns in an article disclosing all of the mechanical and electrical features of the device. The single-phase type of converter, in which a time lag is produced in the diminishing active alternating-current wave until the increasing alternating emf at another electrode reaches such a value as to produce a separate current path, was announced at the Niagara Falls convention of the American Institute of Electrical Engineers in June, 1903. A description of the converter in its practical operating form was given in our issue dated Feb. 10, 1906.

In all of the earlier types use was made of a lower negative electrode of mercury held within a glass envelope, through the top portion of which were inserted two or more positive electrodes which in operation became active successively. Numerous mechanical and thermal causes, including expansion, leakage and temperature elevation phenomena, tended to limit the permissible output to from 30 amp to 50 amp. In the latest form use is made of a metallic envelope through the top of which the positive electrodes are inserted by way of porcelain tubes. The different parts are subjected to artificial cooling according to the amount of heat produced locally. That the limitations in output have been overcome is shown by the fact that one of the converters has operated at East Pittsburgh for a month at 200 kw without being re-exhausted.

This new form of converter can be employed not only where synchronous converters are now used, but also in certain other services where synchronous converters would prove disadvantageous. For example, in electric railway work it is desirable to use a high-voltage alternating-current system with ordinary direct-current series railway motors for propulsion. As a connecting link between the alternating-current supply system and the direct-current motors, the synchronous converter is not well adapted by reason of well-known mechanical and electrical limitations. However, the latest form of Cooper Hewitt rectifier is light in weight, small in size, requires little attention and can be regulated with the maximum of simplicity. The control apparatus can be exclusively of the simple variable-potential alternating-current type, which is far more economical than any present form of either direct-current or alternating-current control equipment. The rectifier represents a link in a chain of simple apparatus that allows energy to be transmitted over high-voltage alternating-current circuits and distributed over low-voltage direct-current circuits. The change in voltage takes place in the simple stationary transformer, while the change from alternating to direct current takes place in the almost equally simple rectifier.

IMPROVEMENTS IN GENERATING AND CONVERTING APPARATUS.

At a meeting of the technical division of the Commonwealth Edison Company Section of the National Electric Light Association held in Chicago on March 13 two papers were read on the general subject of "Recent Improvements in Electric Generating and Converting Apparatus." The first speaker was Mr. J. C. Johnson, of the Quarry Street station, who took up first the advancement in power-station machinery. He said that 24,000-kw alternators will soon make their appearance, and remarked that all new generators for the Commonwealth Edison stations are wound for half of the line voltage, with auto-transformers in the generator leads, not only raising the voltage but acting also as reactance coils. The speaker referred to modern low-pressure steam turbines and large induction generators. The new hydroelectric generating stations keep pace with the steam stations in size of units and refinement in design. In the power house of the Washington Water Power Company, of Spokane, Wash., generating units of 17,400 kw are in operation. Improvements in step-up transformers were noted, with the statement that 5000-kw units for 110,000 volts on the outgoing lines are in use in several installations, while transformers for even higher potentials are about to be put into service. Oil switches have been increased in size and are now used to rupture circuits carrying 2000 amp or more. There has been great improvement in the manner of connecting the generators in large modern generating stations, and in disconnecting switches, series transformers, switchboard equipment, and fuses for protecting potential transformers there has been marked improvement within the last few years. There is room for improvement, however, in the design of relays to protect tie lines between stations. Mr. Johnson also spoke of the improvement in substation apparatus, including rotary converters. He exhibited several lantern-slide pictures, and among other things illustrated the records made by the Schweitzer synchronism recorder.

Mr. R. L. Frisby, of the testing department, read a short illustrated paper on some of the novel features of the new Northwestern station of the Commonwealth Edison Company. He spoke of the arrangement of the exciters in the new station and the disposition of the cable leads, but said that perhaps the use of the auto-transformers mentioned by Mr. Johnson was the most novel feature of the station. (See article in the *Electrical World* of June 1, 1911, page 1401, for more detailed reference to the principal features of the Northwestern station.) These transformers are both oil-cooled and water-cooled, with special arrangements for draining the oil and for connecting reserve transformers in case of necessity. The arrangement of the switch house at the Northwestern station was described by Mr. Frisby, also the novel testing set there installed. He pointed out the fact that this very large station was almost a pure alternating-current installation, all motors, including crane motors, being operated by three-phase, 60-cycle energy.

Mr. P. B. Juhnke, chairman of the division, presided. In the discussion Mr. Peter Junkersfeld spoke of the development of turbo-generator design and remarked that in the new machines the speeds at which the comparatively small units will be driven will be much higher than anything now in use. Mr. Junkersfeld also pointed out that the two great necessities for successful central-station business on a large scale are centralized production and the creation of a diversity factor. Indeed, the diversity factor furnishes the fundamental economic reason for the existence of the electric central station. It has enabled the Commonwealth Edison Company to report a load factor of 44 per cent for the year 1911.

Mr. R. F. Schuchardt spoke of the constant tendency toward large generating units and higher efficiency. The Commonwealth Edison engineers have a right to take pride

in the fact that their company was among the first, if not the first, to use three-phase transmission with rotary-converter substations for distribution, also perhaps the first to use very large vertical turbo-generators, the first to use vertical rotary converters and motor-generators and one of the first to use large split-pole rotaries. The largest rotaries now in use are of 3000 kw, but machines rated at 4000 kw are being designed. In substation equipment, as in generating stations, the tendency is toward the use of larger units as the density of the load increases.

Mr. D. Macrae spoke of the part played by the $2,500,000 worth of storage batteries installed in the company's stations and substations. Mr. W. A. Durgin referred to the imperative need of protective devices in the large modern generating stations. The greatest question before the electrical engineers of to-day is to localize trouble on the lines before it gets to the turbine. Messrs. George B. Foster, D. W. Roper, D. D. Higgins, Guy Lunn, M. Rich and others took part in the discussion.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

The Kings County Electric Light & Power Company has filed with the New York Public Service Commission for the First District an application praying for permission to issue $1,000,000 in 6 per cent debenture bonds, convertible at par into stock after three years. Commissioner Milo R. Maltbie will hold a hearing on the application March 20. In 1909 the company applied for permission to issue $5,000,000 in such bonds, and the commission approved an issue of $4,000,000. The company now asks for permission to issue the remaining $1,000,000, the proceeds of which will be used for the purpose of restoring the company's surplus expended in the construction, extension and betterment of its plant and distribution system.

Tests of gas and electric meters made by the commission during the month of February, 1912, included 570 gas meters tested on the complaint of consumers. The result showed that 37.2 per cent of such meters were found fast, 13.3 per cent slow and 49.5 per cent within the limits of accuracy as defined by law—namely, between 2 per cent fast and 2 per cent slow. There were eighty-four electric meters tested on complaint, of which 5.9 per cent were found fast, 4.8 per cent slow and 89.3 per cent within the limits of accuracy allowed by law—namely, between 4 per cent fast and 4 per cent slow. The total number of gas meters, including new meters, repaired meters and complaint meters tested during the month of February was 31,910.

During the past week the commission sent to the Board of Estimate and Apportionment the proposition received from the Interborough Rapid Transit Company Feb. 27 last for the extension of the city subway system and its operation by that company. In this proposal the company offers to contribute $77,000,000, of which $56,000,000 will be for construction and $21,000,000 for equipment, provided that the city shall expend $56,000,000 for construction. It also offers to extend and third-track its elevated lines at an estimated expense of about $30,000,000 additional, and to turn over to the city the Steinway Tunnel, under the East River, at a cost of $3,000,000 and make it a part of the subway system. The receipts from the existing subway and the new lines are to be pooled, and after deducting operating expenses the company is to receive $6,335,000 per annum and a sum equal to 6 per cent per annum upon its new investment of $77,000,000, after which the city is to be paid interest and sinking fund upon its bonds issued for construction and such further sum as will make the return to the city 8.76 per cent upon its investment. After this any surplus is to be divided equally between the city and the company. In its communication to the Board of Estimate and Apportionment the commission says: "The present Interborough proposition is so advantageous to the city and to the traveling public that every proper means should be used to secure it as a part of the dual system." The dual system referred to is the proposed agreement of July, 1911, providing for the operation of the present subway and new extensions by the Interborough Rapid Transit Company, and for a new subway under the East River, up Broadway to Fifty-ninth Street and through Fifty-ninth Street to the Queensboro Bridge, with other extensions, to be operated by the Brooklyn Rapid Transit Company.

On March 14 the commission took testimony in an investigation, on its own motion, of the circumstances attending the discontinuance of the Brooklyn Edison Company's service to William Bradley, contractor for two sections of the Fourth Avenue subway in Brooklyn. Part of the construction work on these two sections of the subway involves excavation below the level of tidewater, and considerable use is made of motor service for driving centrifugal pumps. A dispute had arisen between the Bradley company and the Brooklyn Edison company over a bill rendered to the former covering reimbursement of costs for reconstructing part of the Edison company's underground distribution system, made necessary by the subway work. On March 12 the Edison company suddenly shut off the service, late in the afternoon, following the refusal of the contractor to make a large payment on account. This left the work in darkness and permitted the water to rise very rapidly. The representatives of the Bradley company immediately appealed to the commission, and after a short delay Commissioner Maltbie succeeded in having the service turned on again. At the hearing the company's representatives admitted having shut off the service and sought to justify it on the ground that the contractor had disputed their bill of about $9,000 for reconstruction work. It developed that the bills for motor and lighting service had been paid and were not in dispute. One of the points emphasized by the contractor, and also by the commission, was the great risk attendant upon a sudden discontinuance of motor service, which would permit water to rise very rapidly in the excavation and endanger overhead railroad structures which were carried upon temporary supports. Toward the close of the hearing the contractor volunteered to submit the disputed bill to the commission for arbitration. Commissioner Maltbie called upon the company to state within three days what provisions they had placed in force to prevent a recurrence of the matter, meantime reserving decision.

Hearings took place on March 14 and 18 before Commissioner Maltbie, of the First District, on the complaint of certain organizations of stationary engineers which allege that discriminating rates are given by the New York Edison Company. At both of these hearings, Mr. Edgerton, who is identified with the complainants, occupied the stand and presented his personal views at great length.

WISCONSIN COMMISSION.

An order has been issued by the Wisconsin Commission in the complaint against the traction service furnished in the city of Madison, Wis., by the Southern Wisconsin Railway Company. This order succeeds a thorough investigation by the engineering staff and directs the company to make certain improvements in its schedules and such improvements in its track and equipment as may be necessary to secure the desired quality of service. Certain of the company's rules and regulations which were not considered to be in the interest of good service were ordered amended or discontinued. The company is allowed until July 1, 1912, to carry out the full provisions of the present order, and the investigation is being continued to cover certain remaining portions of the system.

The commission has taken preliminary testimony in the matter of the application of the Interstate Light & Power Company for a certificate of public convenience and neces-

sity. The applicant desires to extend its high-tension transmission system so as to include certain zinc mines in the vicinity of Mineral Point, in southwestern Wisconsin. The Mineral Point Public Service Company, now furnishing light and power to the city of Mineral Point and a number of towns and mines in the neighborhood, vigorously opposed the granting of the certificate on the ground that it has permits from the various townships for the erection of a 60-mile transmission system to loop the mining district and supply the same territory as the applicant has under consideration. A portion of this transmission system has been built, and the plans and specifications have been drawn up for the complete rehabilitation and enlargement of the power plant which will be necessary before any considerable increase in load can be assumed. Authority to issue stock and bonds for this purpose already has been granted by the commission, and at the hearing it was contended that the threatened invasion by the Interstate Light & Power Company, in a territory which cannot profitably support two companies, had seriously interfered with the sale of these securities. The applicant contended that it was its intention to serve consumers whom the Mineral Point Company is not in position to supply and on that ground urged that no valid objection could be raised on the score of competition. The Interstate Light & Power Company is under the management of H. M. Byllesby & Company, of Chicago.

The Eastern Wisconsin Railway & Light Company has been authorized to issue $100,000 par value of 5 per cent bonds to be exchanged for the entire outstanding stock of the Battle Island Company. This property includes a dam site and water-power on the Wisconsin River, near Knowlton, Wis.

Upon complaint of certain patrons of the service furnished by the Wisconsin Electric Railway Company, between Neenah and Oshkosh, that the present system of fare zones is discriminatory, the commission has investigated and upholds the complainants. Tests and observations were made by the engineering staff and show that the various fare zones were not fixed with reference to the amount of traffic furnished by the various sections. The company is ordered to rearrange its fare zones and avoid all possible discrimination in so doing.

MARYLAND COMMISSION.

The Maryland Public Service Commission continued the hearing of the complaints instituted by the Patapsco Electric & Manufacturing Company charging the Consolidated Gas, Electric Light & Power Company with combining illegally with county electric companies and so manipulating rates as practically to cut off all competition in the section served by the Patapsco company. The latter company asked the commission to compel the Consolidated or other companies to apply the maximum rate which they have established in one section to all sections of the county. It is charged that the rate of the Baltimore County Water & Electric Company for the Relay and Catonsville districts, which are also served by the Patapsco company, is $57 per year for each arc street lamp, while in other sections of the county not served by the Patapsco company the rates for this service are from $75 to $99. Mr. Bloede, president of the Patapsco company, appeared before the commission last week and charged that his business is being ruined by the unfair competition, and he endeavored to show that the price cutting is done only in the districts where competition exists. The complaint filed last week to the effect that the Consolidated company is operating in an illegal combination with other companies in the county was added to the original complaint made by the Patapsco company. Mr. Herbert A. Wagner, vice-president of the Consolidated company, cross-examined Mr. Bloede while he was on the stand in an effort to learn certain details about the Patapsco business, such as cost and rates. The Consolidated company denies that the Baltimore County company is a subsidiary.

OHIO COMMISSION.

The Ohio Public Service Commission has refused to reopen the Kenton telephone consolidation case, thus disposing of the application filed at the instance of Mayor Baker of Cleveland to reconsider the whole matter on its merits, in view of the possible development at an early date of a similar situation in Cleveland. It was argued that the commission should have made a full investigation of the physical properties before authorizing the consolidation.

Attorney-General Hogan has ruled that those mutual telephone companies which were incorporated "not for profit" will come under the supervision of the commission in all cases where they lose their mutual features and engage in business outside of the membership. It is said that this ruling will subject many of them to the provisions of the public utilities law.

Although technically required to investigate and appraise all telephone properties where an application is pending for approval of a bond issue, the members of the commission say they are without funds or proper organization to do this on a large scale. In many instances, so the commissioners say, they have other means of satisfying themselves on the questions involved in such cases, but when an appraisal seems to be needed it will be made.

The city of Akron has filed a complaint against the Northern Ohio Traction & Light Company alleging inadequate local traction service and unsanitary condition of cars, to which the company has replied denying the allegations and asserting that the service is as good as that given in any other city of like size in the country. The company also states that a large amount of money is now being spent to improve the properties and the service.

Current News and Notes

Address by President Taft Before New England Street Railway Club.—President Taft was the guest of honor at the twelfth annual banquet of the New England Street Railway Club at the Hotel Somerset, Boston, on March 19. The occasion was probably the first at which the nation's head has attended a representative gathering of electric railway men and was marked with tremendous enthusiasm. Mr. Taft delivered a powerful address on the great questions before the country and was unanimously elected an honorary member of the club as he left the hall. Among the other speakers were Messrs. Judson C. Clements, of the Interstate Commerce Commission; Thomas N. McCarter, president of the American Electric Railway Association; Frederick J. Macleod, chairman of the Massachusetts Railroad Commission, and Patrick Calhoun, president of the United Railroads of San Francisco.

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Harvard High-Tension Laboratory.—The Harvard Graduate School of Applied Science has received an anonymous gift of a high-tension electrical laboratory which is planned to make one of the most complete installations of its kind ever built. The structure will contain facilities for investigations of high-tension phenomena, including the study of corona effects, insulating materials, insulation of wireless telephone and telegraph equipment, and the fixation of atmospheric nitrogen. The apparatus will include a transformer capable of delivering an emf of 1,000,000 volts and appliances by which 100,000 volts can be obtained for direct-current experiments. Researches will be conducted by Prof. H. E. Clifford in the field of corona losses and insulating materials; Prof. C. A. Adams will take up special instrumental and machinery design; Prof. G. W. Pierce will conduct investigations in wireless telegraphy, and Dr. A. E. Kennelly will take personal charge of telephonic investigations.

HYDROELECTRIC DEVELOPMENT AT KANKAKEE, ILL.—The Public Service Company of Northern Illinois, which has in operation both a steam plant and a water-power plant for generating electricity at Kankakee, Ill., has begun work for a new hydroelectric station on the Kankakee River, immediately north of the steam-generating station, which is itself of recent construction.

* * *

KENTUCKY VALUATIONS OF PUBLIC UTILITIES.—The State Board of Valuations and Assessments of Kentucky is to hold a special meeting in the near future for the purpose of fixing the franchise valuations of every public-service corporation in Kentucky. It has been stated that these interests have not been assessed on a sufficiently high basis, and for that reason it is expected that a number of increases will be made.

* * *

DEFEAT OF KENTUCKY PUBLIC UTILITIES BILL.—The Perry public utilities bill was defeated in the House of Representatives of the Kentucky Legislature on March 6 by a vote of 64 to 22. The Newcomb bill, which also provided for the establishment of a public service commission, was defeated in the rules committee. The prospect of enacting a public utilities law in this State is therefore deferred for a period of two more years.

* * *

STREET LIGHTING IN LOS ANGELES.—The light committee of the City Council of Los Angeles has recommended that the city pay 25 per cent of the annual cost of ornamental street lighting in the central business district instead of 12.5 per cent as at present. On other streets it is recommended that the present division of maintenance cost between the city and the property owners be continued. The city electrician advocates the erection of 500 arc lamps a year, for two years, to supply street lighting to outlying districts.

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THE HUMAN MACHINE RATED.—The average man dissipates about 2.5 kw-hours of energy per day in motion, muscular action, mental exertion and heat radiation. This is equivalent to a continuous expenditure at the rate of about 100 watts, or the rating of a ⅛-hp motor. In spite of his high body temperature (98.6 deg. Fahr.) and large radiating surface, man's heat losses are surprisingly small —about 50 watt-hours per hour, or about one-half of the total energy expenditure. As a heating device the average man is thus about equal to a 16-cp carbon-filament lamp.

* * *

ELECTRICITY IN BOTTLES.—According to "B. L. T.," of the *Chicago Daily Tribune,* an electrical concern has received the following letter: "Lily, Fla., February the 1912. Sir: I rite to find out if you air still in business yet. I am and old agent and want to revive it by saying please send me 2 bottles electricity in a bottle and as soon as I get it I will send the money for it. If I had none you was still there I wood have sent it right along for my wife has got the Asthama and other parties want it so please send the 2 bottles right along. don't be afaraid to trust me." The writer probably had a vague recollection of an advertisement widely published some years ago offering, for curative purposes, negative electricity in green bottles and positive electricity in red bottles.

* * *

ELECTRIC HEATERS FOR BEAR CAGES IN BRONX ZOO.—Contrary to popular opinion, all bears are not polar bears, and many of those in the Bronx Zoological Gardens, New York, come from climates more temperate than that of New York. During the very cold weather of February there was considerable danger of some of the rarer specimens contracting pneumonia, and it became necessary to warm the quarters inhabited by the grizzlies and others. Owing to the long lengths of piping necessary, steam was out of the question for heating purposes and electric radiators were installed in each den. The energy was supplied from the mains of the New York Edison Company, and lest the beneficiaries should become too affectionately disposed toward their new heaters the latter were protected by heavy bars.

* * *

MECHANICAL STRESSES IN TRANSMISSION LINES.—Bulletin No. 54 of the engineering experiment station of the University of Illinois consists of a paper on "Mechanical Stresses in Transmission Lines," by Mr. A. Guell. Of the stresses to which lines of wire for the transmission of electric current are subjected, this bulletin discusses the following three: (1) Dead weight; (2) wind pressure; (3) change of temperature. Approximate and exact formulas are derived for use in the calculation of such stresses. A numerical example given shows that for very long spans and great sags the parabola method of calculation, commonly used by engineers, is inadequate. Evidence is presented to show the superior advantage of the catenary method, and also to show that this method is sufficiently simple and accurate to serve the purposes of practice. A copy of the bulletin may be obtained gratis upon application to the engineering experiment station.

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ENGLISH TARIFFS FOR ELECTRICAL ENERGY.—At a meeting of the Institution of Electrical Engineers (London), held on March 7, Mr. W. W. Lackie presented a paper entitled "Tariffs for Electrical Energy, with Particular Reference to Domestic Tariffs." The paper is devoted to a discussion of the maximum-demand system of charging and describes a modification of this system for domestic consumers which is virtually a flat rate. A modification of the maximum-demand system is also explained, under which the monthly hours of use of the maximum is changed every two months, or six times per year, being 150 hours per month in December and January and twenty hours per month from April to July, with a total of 800 hours use of the maximum per year. The author presents a comprehensive analysis of 20,720 consumers' accounts, classified according to both hours and character of use. He urges simplicity in the method of charging, and claims that in this respect English systems are ahead of those in America, supporting the claim with the statement that the Edison Electric Illuminating Company of Boston publishes its rates in an eight-page pamphlet.

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MEETING OF NEW YORK COMPANIES' SECTION OF THE N. E. L. A.—The March meeting of the New York Companies' Section of the National Electric Light Association was held in the Edison Auditorium, New York City, March 18. Mr. Henry L. Doherty, the chief speaker of the evening, lectured on thrift, the brunt of the talk being devoted to the wage-earner as an investor. Mr. Doherty is endeavoring to awaken the interest of financiers and captains of industry in the wage-earner and his savings, while at the same time impressing on the wage-earner the expediency of investing his money in securities yielding 7½ per cent instead of from 2 to 4 per cent. The speaker felt that by this means the feeling of unrest and dissatisfaction among the workers could be dispelled. The lecture was illustrated by numerous charts, and Mr. Doherty requested the chairman of the section to see that neither the charts nor his lecture was given out for publication. Following Mr. Doherty, Mr. James W. Erwin, official lecturer of the Southern Pacific Railroad Company, gave a very interesting account of the sights to be seen on a trip from New York to San Francisco. The talk was superbly illustrated by means of two hundred beautiful views in color and many unique and instructive motion pictures.

Kansas City N. E. L. A. Section.—A section of the National Electric Light Association has been formed at Kansas City, Mo., with Mr. E. J. Bowers as chairman and Mr. J. M. Arthur, Jr., as secretary. Membership in the section will include persons residing in St. Joseph, Mo.; Atchison, Topeka and Leavenworth, Kan., as well as Kansas City.

* * *

Railroad Conventions in Chicago.—The thirteenth annual convention of the American Railway Engineering Association was held at the Congress Hotel, Chicago, on March 19 to 21, inclusive. This is the association generally known for a number of years as the "Maintenance of Way" Association. Various committee reports, including that on "electricity," were discussed. More extended reference to the proceedings of the convention will be made next week. On March 18 there was a stated meeting of the Railway Signal Association at which progress reports were made on such subjects as alternating-current specifications for automatic signaling, standard plans for mechanical interlocking, relays and channel pins. During the week an excellent exhibition of railway appliances was given at the Coliseum.

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American Society for Promoting Efficiency.—Following a two-day opening session held in the Engineering Societies Building, New York, on March 18 and 19, the American Society for Promoting Efficiency was organized with an enrolled membership of more than 800. Mr. Henry R. Towne was elected president and the following directors were chosen: Messrs. Bion J. Arnold, Chicago; Roger W. Babson, Wellesley, Mass.; W. C. Brown, New York; James G. Cannon, New York; M. E. Cooley, Ann Arbor, Mich.; W. W. Freeman, Brooklyn; W. F. M. Goes, Urbana, Ill.; Luther H. Gulick, M. D., New York; William McConway, Pittsburgh; H. R. Hatfield, Berkeley, Cal.; Melville W. Mix, Mishawaka, Ind.; Isidor Straus, New York; George Westinghouse, East Pittsburgh, Pa., and Schuyler S. Wheeler, Ampere, N. J.

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Westinghouse Banquet.—The employees of the various Westinghouse companies held a banquet in the Fort Pitt Hotel, Pittsburgh, March 16. Approximately 500 covers were spread and the affair was most successfully conducted. Mr. E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, acted as toastmaster, and the speakers and topics were as follows: Mr. A. L. Humphrey, Westinghouse Air Brake Company, "The Power of Air"; Colonel H. G. Prout, Union Switch & Signal Company, "Co-operation"; Mr. T. E. Clifford, Pittsburgh Meter Company, "Gas"; Mr. G. W. Guthrie, ex-Mayor of Pittsburgh, "Pittsburgh"; Mr. Guy E. Tripp, chairman of board of directors Westinghouse Electric & Manufacturing Company, "Public Relations"; Mr. J. J. Jackson, attorney Westinghouse Electric & Manufacturing Company, "Entropy," and Mr. E. H. Sniffen, sales manager Westinghouse Machine Company, "Steam."

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Inductance of Coils.—A bulletin (No. 53) by Profs. Morgan Brooks and H. M. Turner has just been issued by the Engineering Experiment Station of the University of Illinois, which discusses the theory and determination of the self-inductance of coreless coils. An empirical modification of the common formula for the inductance of solenoids is presented as the Brooks universal formula applicable to all forms of cylindrical coils. Easy methods are given for predetermining the dimensions of a coil for any required reactance or inductance, for any purpose from the massive power protective coils to the smallest instrument coils. Definite coil proportions are assigned for producing the maximum inductive effect with a given length of conductor, and data are furnished on the relation of the mutual inductance of adjacent coils to their self-inductance. Copies of the bulletin may be obtained gratis upon application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

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SOCIETY MEETINGS.

Chicago I. E. S. Meeting.—"The Influence of Spectral Character of Light on Effectiveness of Illumination" was the subject of a paper by Mr. M. Luckiesh, Cleveland, Ohio, read at a meeting of the Chicago Section of the Illuminating Engineering Society on March 21.

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Northwest Electric Association Convention.—The executive committee of the Northwest Electric Light & Power Association has selected Sept. 12, 14 and 16 as the dates for holding the next annual convention in Portland, Ore. The secretary of the association is Mr. N. W. Brockett, Cataract Building, Seattle, Wash.

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Electric Vehicle Association of America.—The regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, New York, March 26. "Efficient Charging of Electric Automobile Batteries" is the title of the paper to be presented, and its author is Mr. J. F. Lincoln, of the Lincoln Electric Company, Cleveland, Ohio.

* * *

Birmingham Electrical Engineers.—The Birmingham (Ala.) Association of Electrical Engineers, which was organized in June, 1911, has an enrolment of fifty members among the electrical engineers of the Birmingham district. Meetings are held regularly on the second Monday of each month. The president of the association is Mr. H. M. Gassman and the secretary-treasurer Mr. W. H. Fleming.

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Philadelphia I. E. S. Meeting.—At a meeting of the Philadelphia Section of the Illuminating Engineering Society held on March 15 Prof. Arthur J. Rowland delivered the third of his series of educational talks on shades and redistribution of light, Dr. Herbert E. Ives presented a paper entitled "The Application of Photography to Photometric Problems," and Dr. Clayton H. Sharp discussed European lighting. The attendance at the meeting totaled 153.

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Jovian Luncheon, New York.—There was the usual large attendance of the members of the New York branch of the Sons of Jove at the regular luncheon held at Kalil's Restaurant on March 20. Mr. T. M. Debevoise, the principal speaker, delivered an interesting address on "Electrilal Merchandising," in which he dwelt on the important position occupied by the jobbers in the electrical industry and the benefit which the members of the order would derive from the continuance of its co-operative work.

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Baltimore Sons of Jove.—The Baltimore branch of the Sons of Jove held the first of a series of weekly luncheons at the Carrollton Hotel last week. In order to stimulate interest, a theatre party has been planned for Thursday evening, March 28, when the Sons will see "Rebecca of Sunnybrook Farm." The officers of the Baltimore Chapter are: Messrs. Herman Samuels, William F. Tanner, H. M. Jones, Henry A. Shepherd and Charles H. Lamar. A smoker will be held before the performance at which time the boxes and orchestra seats will be auctioned.

ELECTRICAL INSTALLATION OF MOUNT WILSON SOLAR OBSERVATORY.

Complete Electrical Equipment for Operation of Giant Telescope—Description of Various Auxiliary Electrical Apparatus—Representation of Solar Conditions by Powerful Electric Furnace.

By Howard S. Knowlton.

THE importance of electricity as an auxiliary in the conduct of research work is nowhere better illustrated than in the field of astronomical investigation. The widest range of service is demanded by the present-day astronomer from the equipment at his disposal, for the cost of research limits the variety of apparatus available in many instances and necessitates the most efficient use of all available resources. The safe and accurate movement of heavy mechanism, the refined adjustment of delicate apparatus and the specialized illumination of equipment parts provide an attractive field of service for electricity. Within recent years also electricity has come to the front in connection with the duplication of observations in the astronomical laboratory for the purpose of checking the interpretation of phenomena recorded at the telescope and spectrograph. Intensified electric heating plays an important part in some of the latest work of this kind, and by its aid many striking advances are being made in the world's knowledge of heavenly bodies.

PURPOSE OF THE OBSERVATORY.

One of the most famous astronomical research plants in the world is the Mount Wilson Solar Observatory of the Carnegie Institution of Washington, located near Pasadena, Cal., at an altitude of about 5900 ft. above sea level, on the summit of one of the principal peaks of the Sierra Madre range. Within the past five years, under the directorship

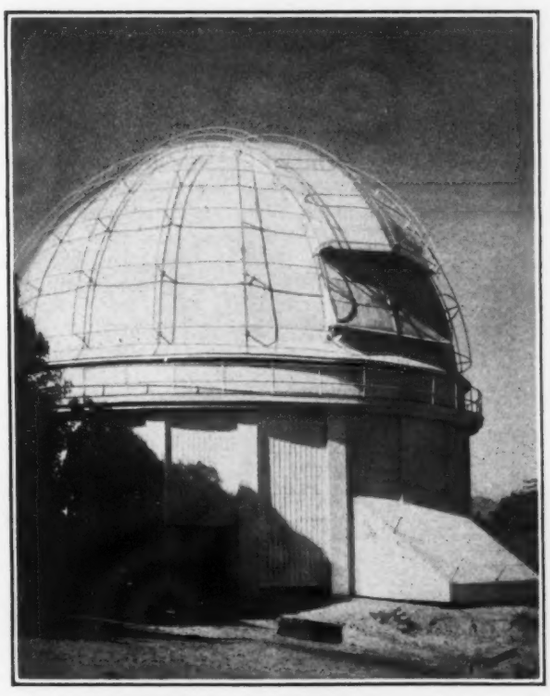


Fig. 1—Dome of 60-in. Telescope.

of Dr. George E. Hale, this observatory has contributed so much new material to the study of stellar evolution that it is safely the leading organization of its character in the astronomical field. At almost every step electricity has greatly facilitated the progress of the work, and it is probable that only a small fraction of the results attained could have been had without the use of specialized equipment for lighting, heating and motor service.

GENERAL EQUIPMENT.

The observatory proper is situated on the summit of the mountain, the principal laboratory, shops and storehouses being located in Pasadena. The more important equipment

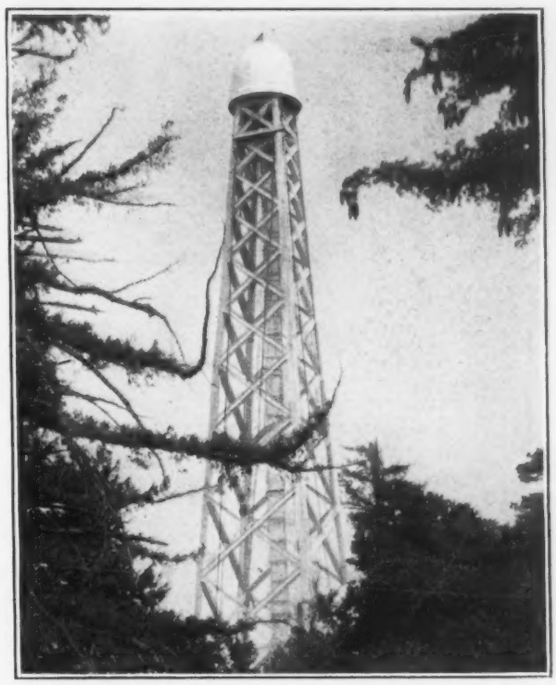


Fig. 2—Mount Wilson Observatory Tower.

of the observatory consists of a 60-in. reflecting telescope, the so-called Snow horizontal telescope and two vertical "tower" telescopes, 150 and 60 ft. high respectively. An auxiliary laboratory and small shop are also located on the mountain, with a plant for supplying electrical energy to the various buildings. The great majority of supplies are transported to the observatory by muleback over a trail about 8 miles long, from the base of which, in the village of Sierra Madre, fast and frequent service is given to and from Los Angeles by the Pacific Electric Railway.

ELECTRIC TRUCK IN MOUNTAIN SERVICE.

Perhaps the most conspicuous service ever rendered by electricity at the observatory was in connection with the transportation of the principal parts of the 60-in. reflecting telescope from Pasadena to the summit of the mountain. To accomplish this an old 10-mile trail 30 in. wide was rebuilt into a road 10 ft. in width. The width was determined by the size of the large castings to be transported, and in addition to the telescope parts a large amount of structural steel was handled over the new thoroughfare. The equipment was hauled up the mountain by a 5-ton "Couple-Gear" gasoline-electric truck equipped with a 40-hp Brennan engine driving through gearing a 17-kw, 125-volt direct-current generator mounted on the chassis. In each of the four wheels of the truck was mounted a 6-hp motor. The truck was operated on grades varying from 10 to 20 per cent, and two days were required in making each ascent. Two steering-gear equipments were provided, and the truck could be turned in a very small circle and steered from either end as desired. About a dozen loads were carried up the mountain in connection with the erection of the 60-in. telescope. At the present time a 100-in. glass is being ground in the Pasadena shops, and it is probable that electric transportation will be brought into play again in connection with the haulage of this equipment up the mountain. The 100-in. outfit will be the largest telescope in the

world, and, besides being operated by small motors with push-button control, it will, like the 60-in. glass, have been ground entirely by motor-driven tools. Experience has shown that at the utmost four mules cannot carry over

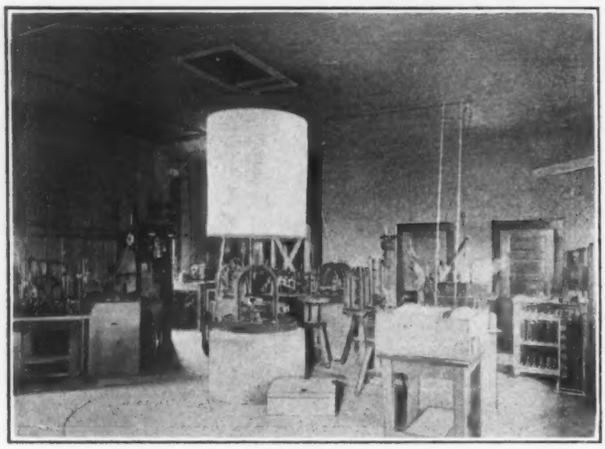


Fig. 3—Interior of Pasadena Laboratory.

750 lb. of equipment apiece, while the gasoline-electric truck carried 5 tons without difficulty.

GENERATING STATION.

Electrical energy used at the observatory is supplied from a small generating station on the summit, which contains a 17-kw, 125-volt compound-wound Westinghouse direct-current generator driven by belt from a horizontal Fairbanks-Morse engine burning distillate, and a 7.5-kw rotary converter giving 80 volts alternating current when supplied with direct current at 150 volts. A 40-kw generator of the 125-volt direct-current type has lately been purchased in addition to the foregoing equipment, and it is to be directly driven by a 50-hp vertical, twin-cylinder Fairbanks-Morse engine. For constant-potential work of great steadiness and for supplying electrical energy to the observatory buildings at night without operating the distillate engine equipment a storage battery has been installed in a special house. This consists of two sets of 55 "Chloride" cells each, wired for either series or multiple operation, and including taps for the supply of energy at special voltages. The battery house is a 26-ft. by 14-ft. concrete structure containing a false roof with about 3 ft. of air space between it and the corrugated-iron roof at the top of the building. This, with the use of canvas curtains to protect the building from the intense rays of the sun, has cut down the evaporation of the electrolyte about 50 per cent. The rafters of the battery house are treated with asphaltum paint in the usual manner, and to facilitate the handling of single cells a portable hand-operated crane of about 750-lb. capacity has been installed. Distilled water is supplied through a 0.5-in. lead pipe connecting with a small still in the neighboring power house.

The electrical service of the plant is controlled at a four-panel switchboard in the power-house engine-room, containing various switches, fuses and instruments designed to enable the output to be utilized in the most flexible manner. These include Cutter inverse circuit-breakers, double-pole, double-throw switches for throwing either generator upon any line or upon either of the two battery sections; switches by which either battery section may be connected with any feeder; four Weston ammeters indicating the charging and discharging current of the battery sections; two watt-hour meters on the battery-discharge service, and a voltmeter. The service of the observatory requires current supplies ranging from 0.25 amp to 350 amp at from 2 volts to 150 volts. All the distribution is effected by cables leading from the power house to the various buildings, these being carried in 2-in. vitrified conduit as the standard method of construction. Two No. 3-0 B. & S. cables are run from the power house to the dome housing the 60-in. telescope, a distance of about 600 ft., and two No. 4-0 cables are to serve the 100-in. instrument and way points when the former is placed in operation.

MOTOR APPLICATIONS TO 60-IN. TELESCOPE.

The extended use of small motors at the observatory illustrates the great convenience of electricity in the manipulation of astronomical apparatus of varying size and weight, ranging from the control of the 60-in. telescope to the delicate service required in rocking photographic plates in the process of development. The great 60-in. reflector, which is one of the two largest existing telescopes, has been in service about three years. It is housed in a steel dome which is rotated by 4 hp in motors, the opening and closing shutter being operated by a 6-hp motor. Inside the dome the observing platform is raised and lowered by a 3-hp motor drive. The fast motion of the telescope in right ascension is operated by a 2-hp motor and the quick motion in declination by a 0.5-hp motor. The slow motions in declination and right ascension are handled by a 0.5-hp and a 0.25-hp motor respectively. Four motors of 1/16 hp each are used in adjusting various convex mirrors in changing the focal length of the telescope. The driving clock mechanism is wound by a 1-hp motor, and when the telescope is used in spectrographic work, a miniature motor is used to operate a 4-in. fan in the prism box, for the purpose of stirring the air and maintaining constant optical conditions. A small electric heater is also required in this work to regulate the temperature of the spectrograph and keep the optical train at a constant degree of heat. An automatic adjustable thermostat is used to control the operation of the heater. Of the moving parts of the telescope, 21.5 tons are carried in a mercury float. The 60-in. mirror itself weighs 1900 lb. The larger parts of the mounting, including the base, polar axis, mercury float, trough and tube, were manufactured by the Union Iron Works, of San Francisco. The construction of all the smaller and more refined parts of the mounting, including the driving clock and its connections, the electric quick and slow motion mechanism, lever-support system for the large mirror, double-slide plate carrier and other details, were fabricated in the electrically driven shop of the observatory at Pasadena. In the earlier days of operation, as a means of keeping the teeth of the principal worm gear in the finest condition, use was made of a small motor by means of which the gear and worm could be repolished at any time, the practice being to disconnect the worm shaft from the driving clock and run the

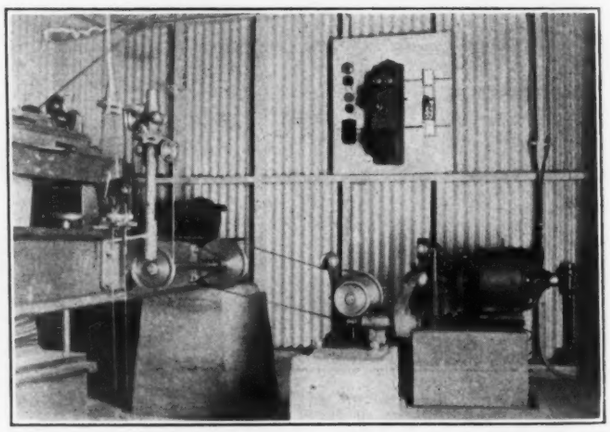


Fig. 4—1-hp Variable-Speed Motor Driving Spectro-Heliograph

gearing together in the lubricant for an hour. The moving parts of the telescope weigh nearly 23 tons. The quick-motion drive provides for a movement of 30 deg. per minute of time in both right ascension and declination. The slow

motion provides for two speeds, one of 6 minutes of arc in a minute of time, for ordinary fine setting, and a slower one of ½ minute of arc in a minute of time for guiding the spectrographs. The observing platform in the dome is raised and lowered by a 3-hp motor, as stated, and this platform can be moved either from the operating floor or from the platform itself by simply pushing a button. It is designed to remain automatically horizontal in all positions.

DOME SERVICE.

The dome is 58 ft. in diameter and is of light steel construction with sheet-metal covering, coated inside with granulated cork to prevent dripping from condensation of moisture, and is painted white outside. It revolves on double tracks which are machined true, the dome wheels being all conical, double and furnished with Hess-Bright ball bearings. It moves with great smoothness. Two motors are used in turning it. One is a 3-hp motor, which is so geared that the dome makes one complete revolution in six minutes, and the other is a 1-hp motor, which drives a variable-speed machine by which the speed of the dome can be changed from one revolution per hour to one revolution in twenty-four hours. This allows the observer, when working on the platform directly attached to the dome, to be moved with exactly the right speed to compensate for the horizontal component of the motion of the telescope. The building has two sheet-metal walls with a 2-ft. air space between and is made air-tight by a water-seal and sheet-metal windows and doors closing against rubber packing. Four "Chloride" cells are installed in the base of the dome building to supply energy for small lamps and time-clock winding. Small 4-volt lamps are used in guiding the eye-pieces of the apparatus. The dome shutter is lined with air-tight cushions which can be locked in place by levers. In the early morning, after a night's work, the dome and building are closed, and thus the great volume of 120,000 cu. ft. of cool air is shut in for the day. This provision, with the complete sun protection of the dome and building, reduces the rise in temperature within the structure to a very few degrees. Special ventilating trap-doors and windows are installed to enable the effect of air currents inside the dome to be nullified.

MOTOR SERVICE IN SNOW AND TOWER TELESCOPES.

In the operation of the Snow horizontal telescope a 1/16-hp motor is used for slow-motion work in right ascension, and two ⅛-hp motors are installed for other slow-motion service. A ½-hp motor is used here in driving a spectroheliograph when making observations of the sun. The Snow telescope is essentially a cœlostat with a mirror 30 in. in diameter, a second mirror being provided to reflect the light back to a concave mirror of 60-ft. focal length which forms a large image of the sun within the telescope housing or laboratory structure. The 150-ft. tower tele-

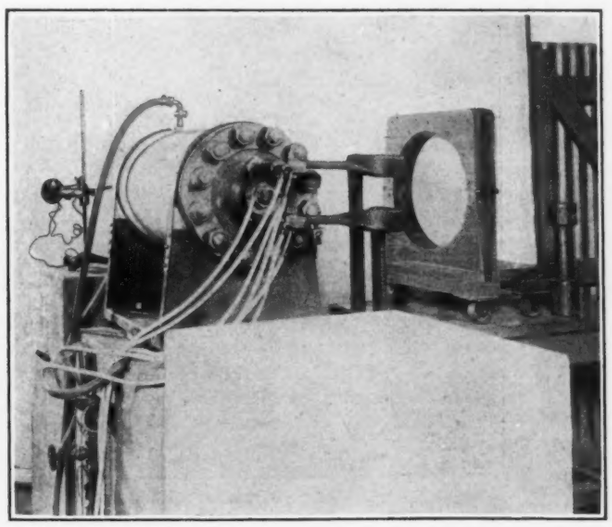


Fig. 5—Electric Furnace Designed by Dr. A. S. King.

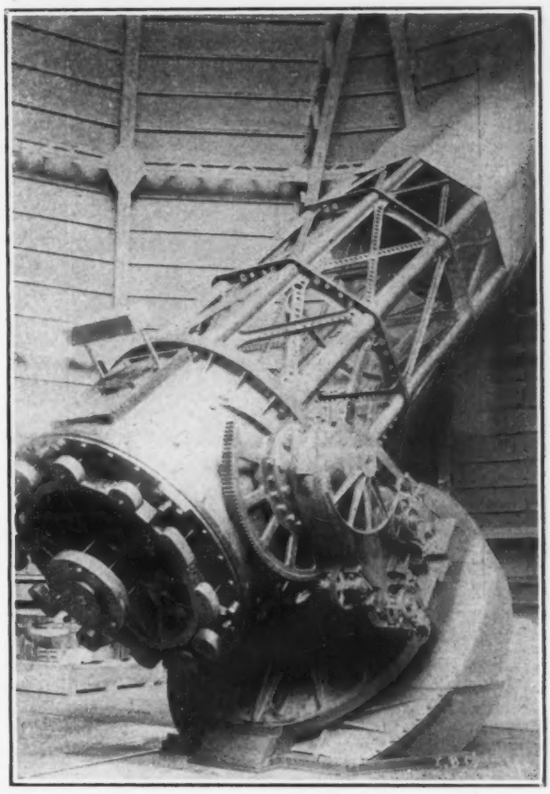


Fig. 6—One of the Two Largest Telescopes in the World.

scope is provided with a 1-hp motor on its dome drive, a 1-hp motor on its cross-carriage, and a 0.5-hp motor on its clock-winding mechanism. Three lens focusing motors of 1 hp each are installed, with two 0.25-hp motors on the cœlostat motions and two similar motors on the so-called flat-mounting mechanism. On the main floor of this telescope building or tower a 1-hp motor is installed for driving a spectroheliograph, and a small electric elevator is in service, driven by a 4-hp motor. A pit in the earth 75 ft. deep is provided for the focus of the lens, and this contains a 0.5-hp motor for rotating a spectroheliograph and three 0.25-hp motors used in focusing, in tipping prism and mirror equipment. A small dark room is provided with a plate-rocking motor for development work. The 60-ft. tower telescope is provided with a 1-hp variable-speed motor driving a spectroheliograph by belting, gearing and reducing pulleys across the image of the sun. The top of the tower is equipped with a slow-motion driving clock motor of 1/16-hp rating, and a motor will shortly be in service for clock winding.

CONTROL AND AUXILIARY SERVICE.

The observatory is standardizing the practice of controlling all motors by solenoid switches governed by push-buttons located in the most convenient places. All solenoids used were designed by Mr. M. C. Dowd, engineer of the observatory, and are provided with double magnetic return circuits. These, with the various knife switches and fuses required at different observing stations, are mounted usually upon insulated panels out of the way of the observer, only the push-buttons being close to the investigator's hand at the moment of taking observations or making adjustments. Besides the applications of electricity at the various instruments, the observatory utilizes energy from its generating plant in connection with water supply and fire protection.

About twenty hydrants are located about the summit, and these are supplied with water from two concrete reservoirs of a combined capacity of 170,000 gal. The water supply is drawn from a camp about 2000 ft. down the mountain on the north side, an 8-hp, 4-in. by 6-in. triplex pump with 300-ft. lift being installed. An independent 2.5-in. by 4-in. fire pump

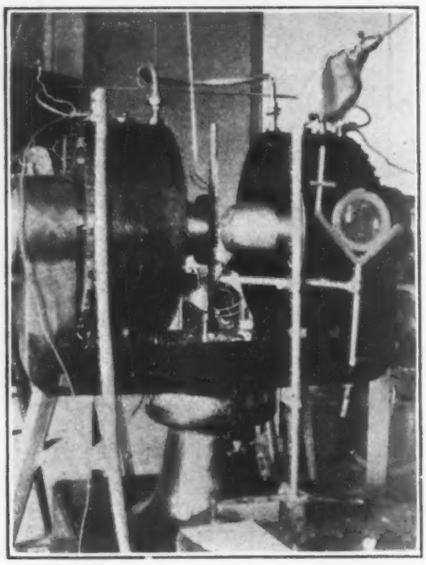


Fig. 7—Electromagnet in Pasadena Laboratory.

driven by a 5-hp motor is also in service. A 5-hp motor-driven concrete mixer is frequently used, and a double-drum electric hoist will shortly be added to the equipment of the observatory. Among the other auxiliary uses of electricity on the summit are the operation of a 1/12-hp motor on a horn-signaling equipment for calling various observers to the telephone, three portable electric drills, a 132-watt electric heater used in keeping photographic developing solution warm in cold weather, ruby incandescent lamps for dark-room illumination, and laboratory equipment service. The latter includes a 1-hp motor operating a small lathe and grinder in a machine shop inside the power house, a focusing arc lamp for enlargement work, storage-battery winding of time clocks and induction-coil equipment for spark investigations, particularly in the comparison of spectra produced between metal electrodes.

PASADENA LABORATORY.

The investigations of sun-spot spectra in the small laboratory erected in 1905 on Mount Wilson made it necessary to supplement the equipment on the summit with a large electric furnace, which was installed at the Pasadena instrument shop. As the further development of sun-spot work required the use of a more perfect electric furnace and as the apparatus demanded energy at a greater rate than it could be generated economically on Mount Wilson, it became advisable to establish a permanent laboratory in Pasadena, where electrical energy could be obtained in sufficient quantity and at moderate cost from the Southern California Edison Company. This step was taken in 1908, and a large shop and laboratory plant is now in service at this point.

In the laboratory at Pasadena the observations on the mountain are constantly being imitated by expert physicists. Here, at the high temperatures of electric furnaces, in sparks, vacuum tubes or flames, the conditions analyzed at the observatory in connection with work upon the heavenly bodies are so far as possible duplicated experimentally. Thus the phenomena exhibited by the vapor of iron and other substances produced in sun-spots have been exactly reproduced in a spark between the poles of a powerful electromagnet, and in the analysis of these conditions and results the evidence favoring the existence of a magnetic field in sun-spots which was furnished by the solar observations made on the mountain has been confirmed beyond all doubt. Extended researches have been made upon the spark spectra of iron and titanium, a new and elaborate study of the Zeeman effect; upon the effect of pressure upon electric furnace spectra, and upon the spectra of vanadium. The results of this work have challenged the interest of the astro-physical world, and, as in the investigations on the mountain, electricity has been indispensable.

ELECTRIC FURNACE WORK.

In general, the laboratory is arranged so that the rays from various light sources can be examined with the utmost convenience, on either horizontal or vertical spectrographs. A constant-temperature well for work of extreme accuracy has been built into the laboratory floor, with waterproof brick walls extending 30 ft. below the surface of the earth. The electric furnace equipment and other light-producing sources stand on rigid piers arranged in general in a circle about the center of the spectrograph slit. The electric furnace equipment includes a new apparatus designed by Dr. Arthur S. King, superintendent of the physical laboratory, this furnace being built to withstand a pressure of 200 atmospheres. This furnace is described in detail in "Contributions from the Mount Wilson Solar Observatory, No. 28," published by the Carnegie Institution of Washington. It has many interesting features, including a heating range rising to 3000 deg. C. maximum, consuming 1000 amp at 20 volts at normal load. The furnace is of the tube-resistor type, the tube being protected from the air. The tube length is adjustable, and jacketing is accomplished by carborundum powder filling the space between the containing half-cylinder and a carbon protector. Agglomerated carbon or Acheson graphite has been used for resistor tubes, the graphite giving the better results. The resistor is incased in a cartridge-type structure of steel with arrangements for water cooling and a plate-glass window of truncated cone shape held with the large end inside by a bronze frame. Energy is taken from a 50-kw transformer supplied at 2000 volts and giving from 5 to 30 volts in four

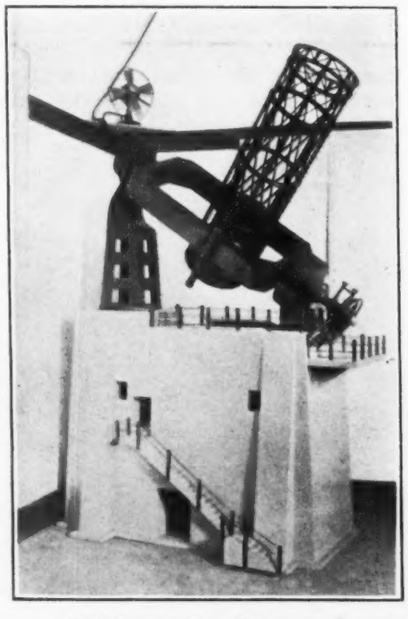


Fig. 8—Model of 100-in. Telescope Mounting.

steps on the secondary. No regulating rheostat is used, the different voltage steps giving the heating range desired. With graphite tubes a temperature of 3015 deg. C. has been obtained, and titanium and vanadium have for the first time been vaporized outside the electric arc. Investigations indicate that the vaporizing point of carbon is much below

the temperature of the hottest part of the carbon arc, making it probable that the high temperature of the positive terminal is due to a superheating caused by a bombardment of this pole by particles impelled by electric forces present in the arc.

ELECTROMAGNETIC AND TRANSFORMER EQUIPMENT.

The electrical equipment of the laboratory also includes a Weiss electromagnet giving a field of 55,000 c.g.s. lines per square centimeter, 120,000 amp-turns being used. The magnet is one of the three most powerful laboratory magnets in the world and absorbs a maximum of 16 kw at 200 volts. It is water-cooled and has a field 100 per cent larger for the same gap than former designs. A DuBois electromagnet is also in service, thus giving 35,000 gausses with 20 amp, at a 0.5-mm. air-gap. A 2-kw motor-generator set, various step-down transformers, air pumps, induction coils and other auxiliary apparatus are in frequent service. The principal high-tension transformer gives a potential of 64,000 volts maximum, with an input of 5 kw, the distributing wires being carried about the laboratory in glass tubes. Fan motors are used in cooling rheostat coils in the laboratory, and pit lighting is handled electrically by incandescent units. Pit wiring is run in conduit. The pit temperature varies by only about 6 deg. throughout the year. The 2-kw motor-generator has a direct-current voltage range of from 90 to 120 and serves well for small arc lamps and other apparatus requiring moderate currents. A 12.5-kw direct-current generator directly driven by a three-phase motor supplies energy to the electromagnetic equipment, and, as stated, the large electric furnace is supplied from a 50-kw transformer, heavy copper cables being run to it through a floor conduit. A motor-driven air compressor is also available.

GRINDING 100-IN. MIRROR BY CENTRAL-STATION SERVICE.

All the tools in the instrument and repair shops of the observatory are driven by electric motors, the group plan being employed at present, although the probabilities are that individual driving will supersede the present installation. Only the most skilled mechanics are employed. About 65 hp in motors is in service in the shops, driving saws, grinders, lathes, drills and other tools of the kind. Induction motors are largely used for this service. The most interesting work under way at present is the grinding of

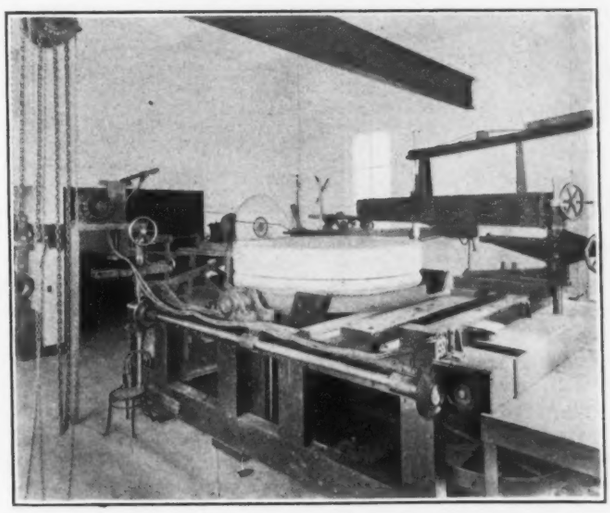


Fig. 9—Grinding the Largest Telescope Mirror, 100-in. Diameter.

the 100-in. mirror for the new reflector. The machinery for this service was developed largely under the direction of Prof. G. W. Ritchey, who was responsible for the grinding and mounting of the 60-in. reflector. The 100-in. glass was purchased through a gift by Mr. John D. Hooker, of Los Angeles. It is 13 in. thick, weighs about 5 tons and was cast by the Plate Glass Company of St. Gobain, France. The work of parabolizing requires the use of the most delicate methods known in astronomical mechanics, and the machinery for accomplishing this purpose is entirely motor-driven. The mirror is rotated beneath a grinding tool capable of varied adjustment, a 5-hp induction motor driving the table, while a 0.25-hp motor is used in moving the tool arm. Extraordinary precautions are taken to avoid injury to the glass surface in the latter stages of the work and near the completion of the task only five minutes' grinding per day with rouge of triple precipitation through distilled water can be accomplished, on account of the danger of molecular disarrangement through heating. The floors of the shop are kept wet at such times, and the workmen are required to wear rubbers, white suits and head coverings. The weight of the moving parts of the completed telescope will be about 80 tons, and the operation will be by electric motors as in the case of the the 60-in. glass. Many thousands of stars and nebulæ never before seen were brought into view by the 60-in. glass, and it is expected that the completion of the 100-in. telescope, surpassing any instrument ever produced in size and power of definition, will add new luster to the triumphs of astronomy.

Acknowledgments are due to Messrs. Adams, F. Ellerman, Dowd and King, of the observatory staff, for courtesies rendered in the preparation of this article.

NEW POWER STATION OF BOSTON ELEVATED RAILWAY COMPANY.

Ultimate Capacity 125,000 kw, with Two 15,000-kw Turbo-Generators Installed—Very Complete Coal and Ash-Handling Equipment.

ONE of the most extensive changes ever planned in New England in the methods of generating and distributing electrical energy has just been placed in service by the Boston Elevated Railway Company, which controls and operates the urban transportation system of the Boston metropolitan district. The work consists of the construction of a steam-turbine generating plant on the waterfront in South Boston, the installation of an extensive system of underground transmission conduits leading to six new rotary-converter substations, the rearrangement of the direct-current feeder and return system, and the elimination of five small direct-current generating plants from the company's energy-producing equipment. For many years the Boston system has been noted for its efficient operation on the basis of direct-current generation, the average production cost at all the stations being under 0.75 ct. per kw-hr. in a yearly period. The principal factors in this result were the tidewater delivery of fuel, short average distance of transmission to the electrical center of gravity in each district, skilled management of plants and co-operative service along tie lines permitting load adjustments consonant with economical station operation.

The growth of the company's service, however, has in recent years indicated the approach of a time when the economic limitations of direct-current generation would be reached, and the present changes mark the transition of the company's system from a direct-current to an alternating-current basis of production and transmission. The work has been carried out by the Stone & Webster Engineering Corporation, of Boston, under a general contract covering the reconstruction of the system in co-operation with the engineering staff of the railway company. The total estimated cost of the work now completed or practically ready for service is $3,750,000.

For the present the company will continue to operate its larger and more efficient steam plants in connection with

the new station at South Boston and its outlying substation system. The former include Lincoln station, 13,500 kw; Central, 12,900 kw; Charlestown, 7000 kw; Harvard, 6300 kw, and Dorchester, 5500 kw. With a single exception, all the units in these plants are engine-driven, direct-current machines, supplying energy to the feeder and trolley system at about 575 volts. The new South Boston plant has an initial equipment rating of 30,000 kw, and the total alternating-current generating rating of the system is now 33,500 kw. The total direct-current equipment rating of the system, including generating plants still in service and substation machinery, is 64,700 kw. As the new plant in South Boston contains space for a third 15,000-kw unit, the total generating rating of the system can be raised to 90,200 kw without building any additional generating plants. The present peak load, occurring in the winter season between 5 and 6 p. m., is 51,138 kw, an increase of 70 per cent in ten years. The six new substations, which supersede the discarded generating plants of small size as sources of local distribution, are located respectively at Coolidge Corner, Brookline; Kendall Square, Cambridge; Arlington, Malden, East Boston and Roslindale. All of these will receive energy from the South Boston plant and will in the main serve the outer suburban areas of the metropolitan district, leaving the business center of the city and the immediate residential districts to be supplied with energy for the most part by the remaining direct-current steam plants. The service of the entire system is electrically controlled by a load dispatcher's organization located at the South Boston station.

The new plant at South Boston is designed to be extended to an ultimate equipment of 125,000 kw and typifies the latest practice in electrical production by large turbine units. It is located on tidewater and on property adjoining the South Boston station of the Boston Edison company, and is characterized by elaborate coal-handling facilities, a coal-storage space accommodating a maximum of 100,000 tons, extensive supply of condensing water with special screening installation, unit boiler plant with modern mechanical stoker system, large turbine room, switching and bus structure.

The coal-handling facilities permit the delivery of fuel by water at all stages of the tide, and the installation is built to handle the unloading of vessels, the loading of trolley cars for transportation of fuel to other stations, filling the boiler-room bunkers directly from vessels, putting coal in storage in the stock pile, reclaiming it and depositing it in the boiler-room bunkers or loading it upon trolley cars or wagons. The entire exterior coal-handling system was supplied by the Mead-Morrison Manufacturing Company, of Cambridge, Mass. The coal-handling installation consists essentially of a 456-ft. by 50-ft. unloading wharf equipped with two structural-steel unloading towers running on 24-ft.-gage rails, with a standard-gage trolley track between for unloading directly into cars; a hoisting equipment in the towers designed for handling a total of 200 tons per hour; a cable-car trestle railway running inshore along the side of the coal-storage area, and a 300-ft. movable steel transfer bridge, hopper and crusher installation. To deliver coal direct from the vessels into the overhead bunkers of the station the cable cars are dumped into a hopper below the trestle opposite an elevating conveyor tower. From there it drops into a crusher and is elevated by an inclined 24-in. Robins belt conveyor to the top of the car-loading hopper. It then falls on a return belt conveyor which elevates it to the top of the tower opposite the coal crusher, from which it falls upon a cross-conveyor leading into the boiler-room under the roof. The discharge from the first conveyor flight can be deflected into the car-loading hopper, which has storage space for 200 tons. The movable transfer bridge spanning the stock pile is equipped with a single traveling electric reclaiming tower designed to handle 200 tons per hour. The storage bunkers over the boilers are served by two longitudinal conveyors, and the fuel is dropped from the bunkers through gates into a traveling weighing crane which distributes it to the stoker installation.

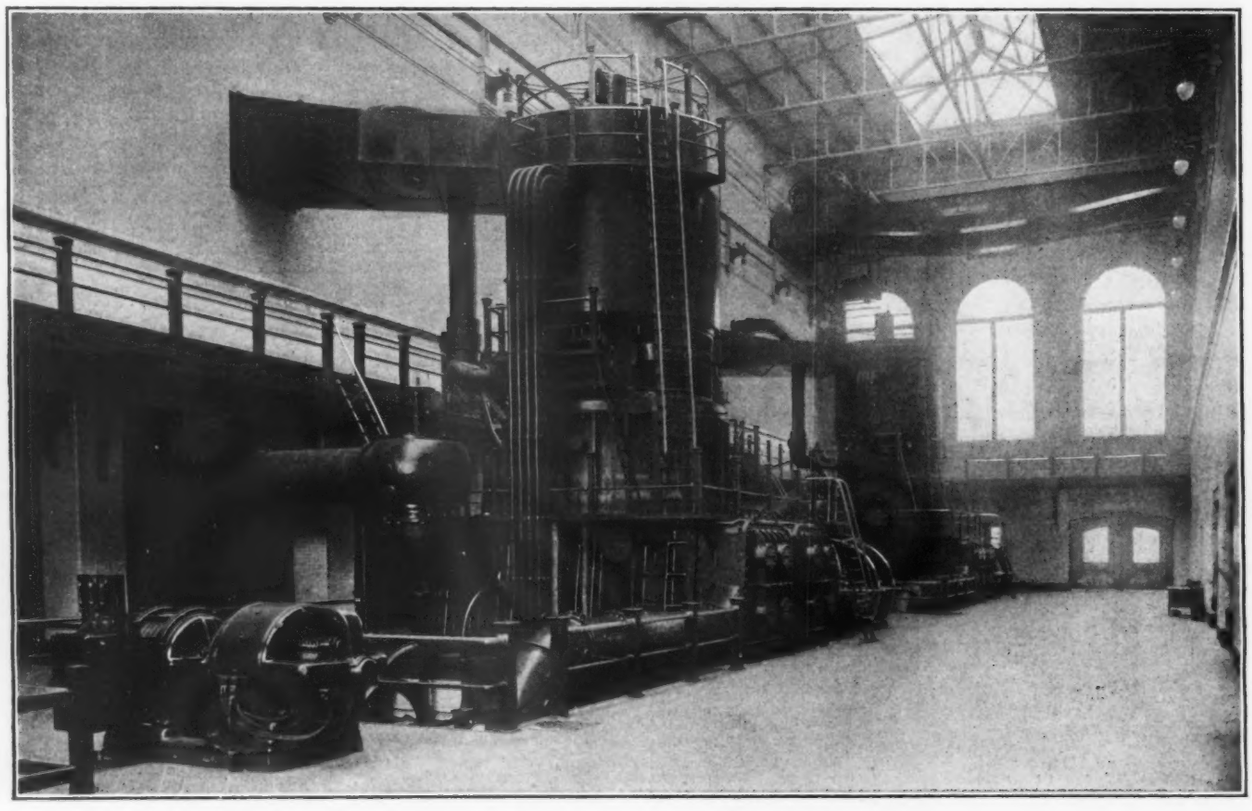


Fig. 1—Interior of Turbine-Room of South Boston Power Station.

The latter consists of a seven-retort Taylor automatic stoker with extension grate for each boiler, the stokers being guaranteed for overloads up to 240 per cent of the boiler rating.

The boiler equipment consists of sixteen 600-hp Babcock & Wilcox water-tube units, the furnaces of which are supplied with forced draft by three Sturtevant Multivane fans having a combined output of 360,000 cu. ft. of air per minute. These are located in the boiler-room basement and are directly driven by 12-in. by 14-in. reciprocating engines located in the turbine-room. The air supply is drawn down through the boiler-room from the space around the smoke flues and is discharged into a common blast duct 4 ft. by 12 ft. in section, located under the firing aisle. Four stoker engines are provided, each being capable of handling eight equipments. Two steel stacks are provided, lined with brick to the top. These are 13 ft. in diameter inside and rise 211 ft. above the boiler-room floor. The stacks are supported on plate girders carried by steel columns, the supporting structure being designed for a maximum height of 225 ft. in case it becomes necessary to increase the draft.

The floor of the turbine-room is carried at the same level as the boiler-room basement, and the dividing wall between the two rooms is carried down only to the level of the boiler-room floor, which leaves a 22-ft. wide open bay under the boiler-room on the turbine-room side. Most of the auxiliary machinery is placed in this bay, the arrangement conducing to economy in labor. Two six-stage, vertical 15,000-kw, four-pole, 6600-volt Curtis turbo-alternators are at present installed, each machine delivering three-phase current at 25 cycles when running at 750 r.p.m. Each turbine is mounted on top of a Worthington surface condenser having 29,000 sq. ft. of cooling surface and capable of condensing 225,000 lb. of steam per hour. The auxiliary equipment includes for each unit a 30-in. Worthington volute, double-suction centrifugal pump designed to deliver 32,000 gal. per minute when running at 195 r.p.m. against a head of 20 ft., the pump being directly driven by a 17-in. by 24-in. Skinner engine; a 14-in. by 35-in. by 30-in. Laidlaw-Dunn-Gordon dry-vacuum pump, and a 6-in. two-stage Worthington hot-well pump of the centrifugal type, directly driven by a Terry turbine. Other steam-driven auxiliary equipment includes two Worthington step-bearing pumps and a Laidlaw-Dunn-Gordon air compressor, the pumps being designed to operate if desired on a pressure of 2000 lb. per square inch. Two R. D. Wood accumulators are provided in connection with the step-bearing system and the water for this service is purified by a Loomis-Manning quartz filter.

One of the most interesting features of the new station is the system of condensing-water service. The intake and discharge tunnels have been designed to handle all the water required when the plant is completed to its maximum size, the former being 13 ft. square and the latter 15 ft. by 13 ft. in cross-section. The tunnels can convey 225,000 gal. per minute. Both tunnels are of reinforced-concrete construction. The intake tunnel opening in the company's seawall is divided by longitudinal concrete walls 24 in. thick into four passages, each of which contains a stationary screen and a revolving screen besides guides for stop-logs and watertight gates. The fixed and revolving screens are inclined at an angle of 15 deg. The revolving screens, which were designed by the Stone & Webster Engineering Corporation, consist of 42-in. linked sections passing around five-tooth sprockets at the top and bottom. The screen sections run in grooved guides formed in the concrete walls and the slack is taken up by an idler drum on the rear side. The top drum is revolved by a motor geared to give the drum a rotative speed of about 1 ft. per minute. The discharge tunnel is located immediately above the intake tunnel, the water being confined in a channel formed by the wall of the supply basin and a timber bulkhead extending out to the harbor line.

Other auxiliaries in the station include three Jeansville boiler-feed pumps driven by Terry turbines, two low-pressure service-water pumps, two 6000-hp Cochrane feed-

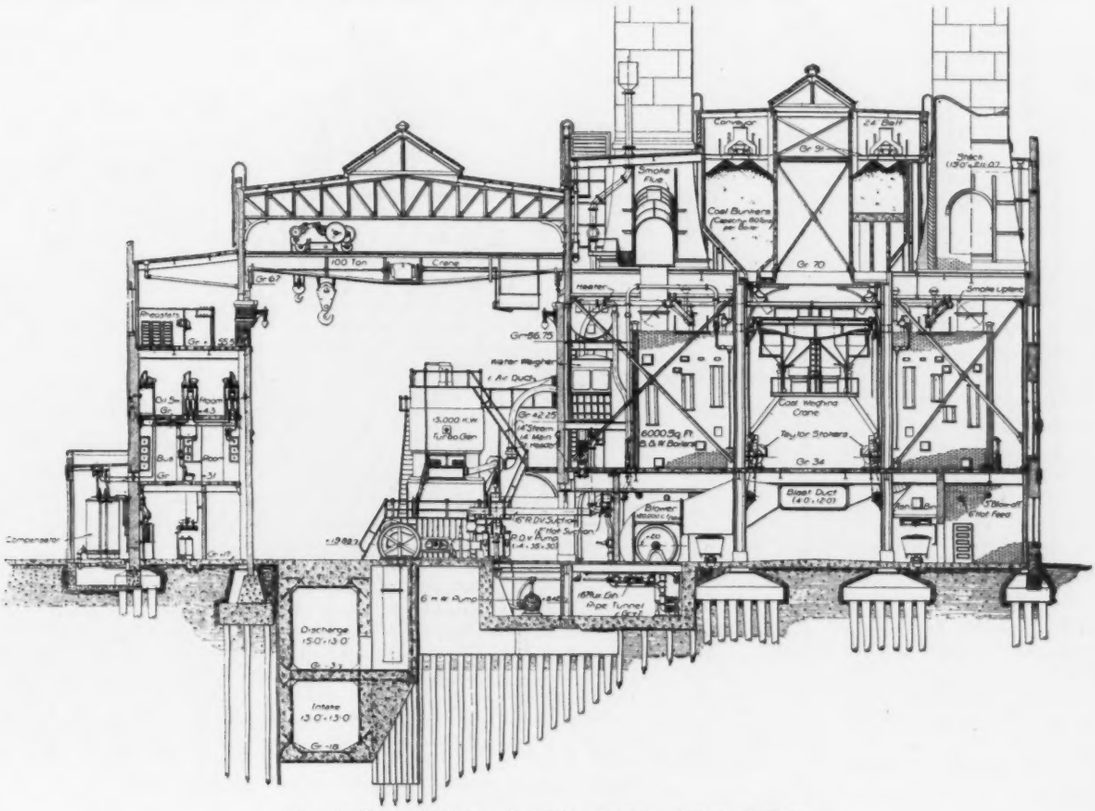


Fig. 2—Cross-Section of South Boston Power Station.

water heaters, and two Worthington water weighers. The main generators are ventilated by an air supply taken from outside the boiler-room roof and carried to the machines by a duct system. Two steam-driven exciters and one motor-operated unit are provided, and for station lighting and crane service when the main units are shut down a 200-kw, 440-volt, three-phase, 25-cycle turbo-generator set is in use. A 100-ton Morgan electric traveling crane serves the turbine-room, the crane girder having a span of 56.5 ft. Four three-phase motors are installed on the crane carriage for hoisting and traversing. Richardson lubricators are used throughout the station and all oil is returned to a filtering system by gravity.

The switching equipment is housed in a four-story structure facing the turbine-room. Local station transformers and outgoing cable terminals are located on the ground floor. The second floor is devoted to generator and feeder buses, and the third to oil switches. On the top floor are an operating gallery, with remote-control benchboard, a rheostat room and a storage-battery compartment, the battery being used in operating the oil-switch motors. The battery is charged by a small motor-generator set placed in the rheostat room. The bus compartments are of reinforced concrete and are designed to facilitate inspection without danger to employees. Duplicate generator buses with sectionalizing switches are provided, and either or both generators can be used to feed any substation from either or both halves of the station buses. Automatic oil switches are used on all outgoing lines. The generator potential is raised from 6600 volts to 13,200 volts for transmission to substations by auto-transformers inserted in between the generators and the high-tension buses, these 1-to-2 transformers being located in brick compartments on the outside of the station wall. All the electrical equipment was supplied by the General Electric Company.

The substations are of similar design, and approximately 50 ft. wide by 80 ft. in length, with a height of 50 ft. to the top of the ornamental front. The buildings are constructed of brick, stone and concrete and are in the main designed to accommodate three rotary converters each. The roofs are formed of reinforced-concrete slabs carried by latticed-steel trusses. The rotary converters, transformers, oil switches and the operating switchboard are mounted on the main floor, a basement being provided for busbar compartments. The converters are mounted on four structural steel columns set in concrete foundations, instead of on the cumbersome concrete piers formerly used. A 25-ton hand-operated traveling crane is a standard feature of the substation equipment.

The reconstruction of the system as above outlined was carried through in less than one year. The cost of the generating plant, underground transmission lines and substations complete was $112 per kw rating of the initial equipment. The extension of the system can be made at a reduced unit cost as the demands of the service increase.

INDUCTIVE REACTANCE OF THREE-PHASE AERIAL CIRCUITS.

Graphical Representation of the Reactance for Unsymmetrically Arranged Conductors.

By R. S. Brown.

WHEN the three conductors of a three-phase transmission system are arranged at the vertices of an equilateral triangle it is quite a simple matter to find the inductive reactance in ohms per mile of wire. In case, however, the wires are arranged in a plane or in some irregular manner, there may be some doubt as to what the reactance really is.

The accompanying diagram gives a ready method for finding the reactance per wire-mile for any arrangement. It is based upon the following analysis, in which:

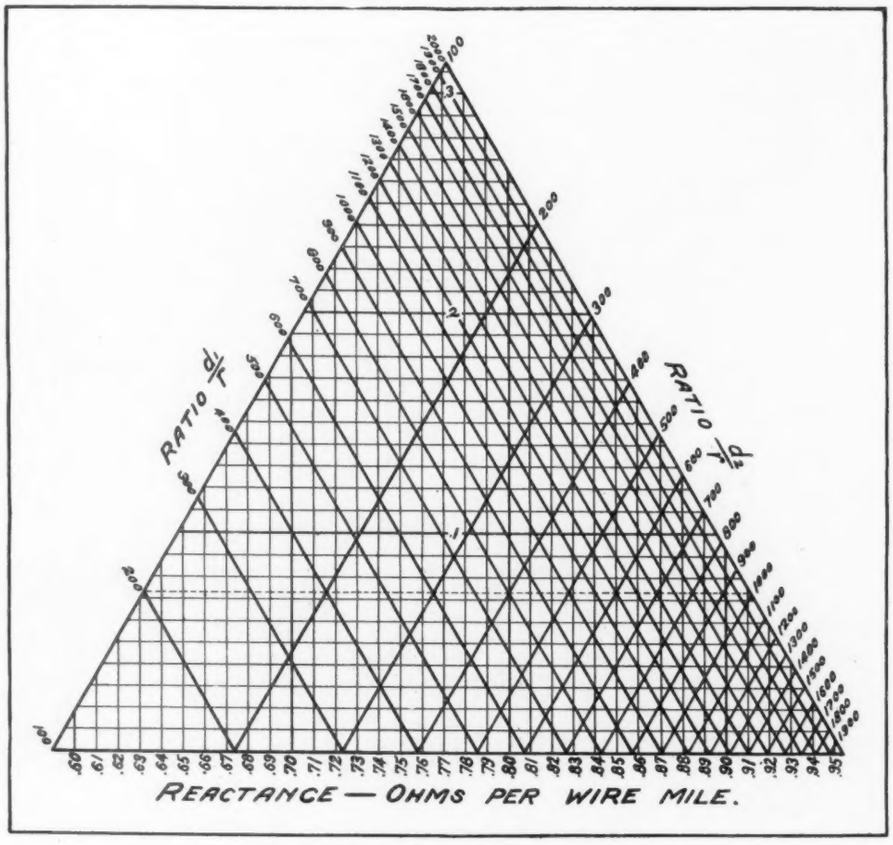


Fig. 1—Logarithmic Reactance Diagram.

ρ = distance measured from axis of wire, inches.

r = radius of wire, inches.

d = distance between wires, inches.

The emf induced in wire No. 1 of Fig. 2 is equal to the rate of change of the magnetic flux which cuts it. This flux consists of four components—the part produced by I_1 within the material of the conductor, the part produced by I_1 without the conductor and the parts produced by each of the other two currents.

Let $I_1 = I$

$$I_2 = \left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right) I$$

$$I_3 = \left(-\frac{1}{2} - j\frac{\sqrt{3}}{2}\right) I$$

The total flux cutting wire 1 is then:

$$\phi = I_1 \int_0^r \frac{\rho^2}{r^2}\frac{2\rho\, d\rho}{r^2} + 2I_1 \int_r^\infty \frac{d\rho}{\rho} + 2I_2 \int_{d_2}^\infty \frac{d\rho}{\rho} + 2I_3 \int_{d_3}^\infty \frac{d\rho}{\rho}$$

$$\phi = \frac{I}{2} + 2I \int_r^\infty \frac{d\rho}{\rho} + 2I\left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)\int_{d_2}^\infty \frac{d\rho}{\rho} + 2I\left(-\frac{1}{2} - j\frac{\sqrt{3}}{2}\right)\int_{d_3}^\infty \frac{d\rho}{\rho}$$

$$\phi = I\left[\frac{1}{2} + \log \frac{d_2 d_3}{r^2} + j\sqrt{3}\log\frac{d_3}{d_2}\right]$$

$$\text{Let } u = \frac{d_2}{r} \text{ and } v = \frac{d_3}{r}$$

Then,

$$\phi = I\left[\frac{1}{2} + \log uv + j\sqrt{3}\log\frac{v}{u}\right]$$

The emf induced in wire 1 by this changing flux is

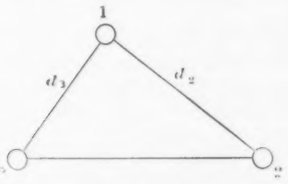


Fig. 2—Diagram for Explaining Symbols.

$e_1 = \frac{d\phi}{dt}$. Since I is a harmonic function of time, $\frac{dI}{dt} = j\omega I$ where $\omega = 2\pi$ frequency.

Therefore,

$$e_1 = j\omega I\left[\frac{1}{2} + \log uv + j\sqrt{3}\log\frac{v}{u}\right]$$

The reactance in ohms per wire mile is $X_1 = \frac{K e_1}{j I_1}$, where K is a conversion factor equal to .00016.

$$X_1 = K\omega\left[\frac{1}{2} + \log uv + j\sqrt{3}\log\frac{v}{u}\right]$$

X_1 is thus seen to be a vector. Let its components be represented by x and y. Then,

$$\begin{cases} x = K\omega\left(\frac{1}{2} + \log uv\right) \\ y = K\omega\sqrt{3}\log\frac{v}{u} \end{cases}$$

From these, by eliminating u and v alternately,

$$\begin{cases} x + \frac{y}{\sqrt{3}} = 2K\omega\left(\log v + \frac{1}{2}\right) \\ x - \frac{y}{\sqrt{3}} = 2K\omega\left(\log u + \frac{1}{2}\right) \end{cases}$$

These equations give two families of straight lines, those with u as a parameter having a slope of 60 deg. and those with v a slope of 120 deg. These lines for sixty cycles are shown on the diagram. They are only plotted above the x axis, as the system is symmetrical about this line. The intersection of lines corresponding to the two values of $\frac{d}{r}$ will indicate the reactance as desired.

It is seen that the reactance has no j component except when the wire considered is equally distant from the other two. The real term in the reactance is always positive, but the sign of the j term depends upon the direction of phase rotation. The plus sign is to be used when the phase rotation is from the wire considered to the further wire; the minus sign is to be used when the rotation is from the wire considered to the nearer wire.

In the case of all the wires being in one plane and the outer ones equidistant from the middle, the j component for each outside wire is the same in magnitude as shown by the dotted horizontal line in the diagram, and is independent of the size of wire and spacing. It is equal at 60 cycles to 0.073 ohm per mile and, as far as impedance drop is concerned, is equivalent to a resistance of this amount being added to one outside wire and subtracted from the other.

This effect is attributable to a transfer of energy by means of transformer action, and in the case of large wires and heavy currents may cause considerable voltage unbalancing at the load. It may be overcome by proper transposition of the conductors.

It is allowable in using the chart to take the average of the three values for numerical calculations. This is especially so if the conductors are transposed at intervals. The average value will always be real, as the sum of the three j components must equal zero.

As an example of the use of the diagram there may be determined the impedance at 60 cycles of 1 mile of three-phase line using No. 2 copper having a resistance of 0.808 ohm, if the three wires are arranged in a plane 6 ft. between outer wires and 3 ft. to the middle wire.

Here $\frac{d}{r} = 280$ and 560.

$$Z_1 = 0.808 + j\,(0.755 + j\,0.073)$$
$$= 0.735 + j\,0.755 \text{ ohms}$$
$$Z_2 = 0.808 + j\,(0.755 - j\,0.073)$$
$$= 0.881 + j\,0.755 \text{ ohms}$$
$$Z_3 = 0.808 + j\,0.713 \text{ ohms}$$

THAWING 6-IN. WATER MAIN UNDER EAST RIVER, NEW YORK.

On March 5 Commissioner Henry S. Thompson of the Department of Water Supply, Gas and Electricity communicated with the New York Edison Company, through Mr. C. F. Lacombe, chief engineer of that department, in regard to the feasibility of thawing by electricity the 6-in. city water main extending from the Bronx shore at the foot of 140th Street to North Brother Island.

This main, 1700 ft. long, under the East River, was frozen solid for its entire length, and all methods tried by the city at considerable expense had failed to relieve the water famine at Riverside Hospital and other buildings on the island. The New York Edison Company appreciated the position of the city and the necessity of speedily obtaining water for the hospital, so that it would not be necessary to remove a large number of inmates—many with contagious diseases—to other quarters, and it agreed to do what it could to thaw the pipe by electricity. A number of years ago this main was frozen and the water supply was cut off for about four months. Mr. W. T. Morrison, manager of the Bronx district, was given charge of this work, and an order for going ahead with the thawing operations was received from the city at 6 p. m. March 5.

The erection of the temporary board substation was

started early on March 6 and four 100-kw transformers were installed. This equipment was afterward increased to 600 kw by the addition of two more transformers. While the transformers were being installed another gang of Edison men laid two submarine cables in a driving snowstorm. The bad weather prevented the laying of the third cable until the following morning, as it was found too dangerous in the heavy wind and storm to continue laying the cable while the steamers were passing through this channel. The final cable installation consisted of three cables, each 2000 ft. long and each cable having a cross-section of 200,000 circ. mils.

The transformers were at first connected for 200 volts and current was turned on the first two cables early on March 7. In the meanwhile the third cable was being laid to increase the current capacity. As the cables were lead-covered, it was necessary to use precaution not to lay them in too close proximity to the pipe; on account of the heavy tide and wind it was very difficult to place them in this manner so that there would be no chance of too much current passing back over the lead sheaths of the cable. The three cables in multiple formed one leg of the circuit and were connected to one terminal of the transformer bank. At the North Brother Island end the cables were connected with large clamps to the pipe, which had been exposed at low tide for this purpose. The pipe provided the return circuit to the transformer bank and was connected at the Bronx shore to the other terminal of the transformer bank.

As the water-piping system on North Brother Island was connected through Riker's Island to the main shore, where it joined another 6-in. main, it was necessary to break the pipe at both ends to prevent any electricity from passing through this pipe. While the thawing was in progress a hydrostatic pressure of from 50 lb. to 80 lb. was maintained at the island end by pumps on one of the city boats.

Conditions were unusually difficult for the thawing of the pipe, as the water in the river was below freezing temperature—an average temperature of 30 deg. was obtained after making several tests. This condition was not improved by a tide of from 5 to 7 miles which prevailed and carried the heat away from the pipe very rapidly,

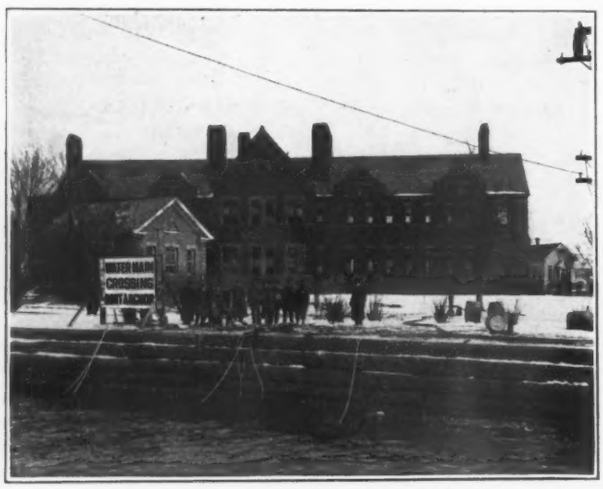


Fig. 1—Cables Attached to Main at North Brother Island.

preventing any accumulation of heat around the pipe, conditions entirely different from those usually prevailing when such pipes are thawed in soil.

While the work was in progress other employees had determined the voltage—by making tests—which would be necessary to pass various currents through the same size and length pipe in soil. The curve plotted from these results was used to determine what voltage connections were necessary on the transformers for the various amounts of current that became necessary on account of the especially severe conditions which have already been mentioned.

A large water rheostat was placed in series with the circuit on the grounded leg to regulate the amount of current through the pipe circuit. Early on March 7 1000 amp was used at 200 volts; on March 8 this was raised to 1200 amp at 248 volts, and on March 9 to 1000 amp at 368 volts.

Fig. 2—Cables Attached to Main at New York End.

The pipe being buried in the icy salt water and dropping suddenly at different points, on account of the uneven bed of the river—in some places dropping from 60 ft. to 80 ft. below the surface—made it impossible to rod the pipe to determine in any way whether the above currents were doing any effective work.

Appreciating the necessity of having more definite data as to what amount of current would prove effective, Mr. Morrison then tried a new plan, by making up a 12-ft. section of the same size cast-iron main and packing it solid with ice. The ends of the pipe were closed and the pipe placed in the bottom of the river after the cable connections had been made, which passed 1600 amp through the pipe for twelve hours. When the pipe was taken up at the end of this time all the ice was melted. The test pipe was again filled with ice and the cables removed; after the pipe was placed in the same position in the river for twelve hours all the ice was found intact with no signs of melting —showing that the current had melted the ice on the previous test.

The big main in the river was then charged with the same amount as nearly as possible—200 amp additional being supplied to provide for any possible leakage which might occur by the current returning in the lead sheath or through other submarine cables, grounds, etc. The amount of current thus determined proved sufficient for thawing the pipe and after being applied throughout March 11 water began to flow early March 12, and the water main was turned over to the city for re-connection, which was completed before 12 o'clock March 12, the island at that time receiving its usual supply of water.

Each cable carried 600 amp, which was a considerable overload, but was not injurious because they were submerged in excessively cold water. The maximum power supplied during this work was 1000 hp. The work was continued both night and day for six days, and the current was on, practically without intermission, for five days, making the job one of the largest and most difficult on record.

The work was particularly interesting on account of the length of the pipe, its exposure to moving cold salt water, and also because of the large amount of energy (44,555 kw-hr.) necessary to accomplish the result.

Central Station
Management, Policies and Commercial Methods

A HURRY-UP TOASTER CAMPAIGN.

Mr. D. E. Nimms, new-business manager for the Grand Rapids-Muskegon Power Company at Grand Rapids, has purchased 1000 General Electric toasters to be placed among the 4000 local residence customers by hurry-up campaign methods. The first broadside of advertising was opened with a circular announcement that these 1000 toasters would be sold at a low price, with privilege of two weeks' free trial, to the first 1000 of the company's 4000 residence users who made application. Telephone reminders to individual customers were also resorted to.

WINTER BUSINESS IN DETROIT.

Although less active than during the preceding months when business-getting records were established as high as 3500 contracts in thirty days, the sales department of the Edison Illuminating Company of Detroit during January, 1912, exceeded all records for previous January business by closing 1764 contracts for electric service. Of these 966 were residence consumers, 386 were transfers from one customer to another, 301 were commercial users and 92 were power contracts.

RIPENING WALNUTS ELECTRICALLY.

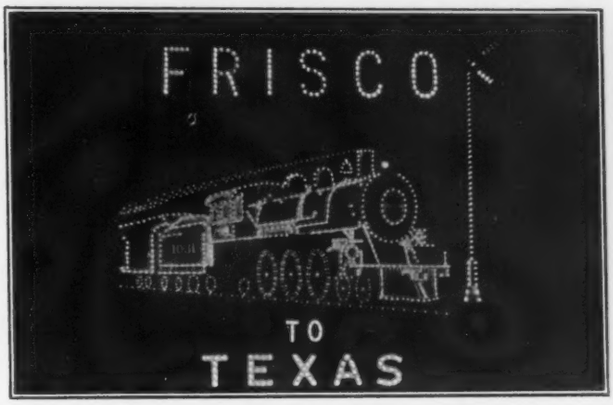
A week to ten days, depending on the weather, is required to ripen walnuts in open trays exposed to the sunshine. On the Pacific coast quantities of these nuts are now being fully cured in twenty-four hours by blowing electrically heated dry air up through them. The trays of walnuts, six deep, are piled in cabinets beneath which are fixed electrically heated grids taking 500 watts to 700 watts per compartment. Air blown through the grids at low speeds is warmed to 140 deg. and thus thoroughly dried by the time it passes over the walnuts. Close control of the temperature and humidity of this air is essential to proper curing.

ELECTRICAL QUESTION BOX FOR THE PUBLIC.

The People's Electrical Page is now published weekly in three Cleveland newspapers, and a similar plan has since been adopted in a score of other cities. An innovation recently introduced in the Cleveland pages is a department for answering electrical questions propounded by the public. All queries of general interest are answered in print, while personal replies are sent to correspondents having questions of less public interest. The class of questions already received indicates that the man in the street has many little electrical riddles he wants solved by some one qualified to answer. Thirty to forty firms, advertising almost as many different lines of electrical apparatus, now use the Cleveland co-operative pages, and so great has the pressure become for space that some of the larger displays have had to be curtailed.

SPECTACULAR LOCOMOTIVE SIGN IN ST. LOUIS.

The number of spectacular electric roof signs in St. Louis is increasing. One of recent creation which is attracting considerable attention is on the roof of a building at the corner of Twelfth and Olive Streets. This sign is 45 ft. high and 35 ft. wide and consists of about 1200 lamps. It advertises the "Frisco" Railroad, and represents a steam locomotive at the head of a train, apparently in motion after receiving an appropriate signal from the semaphore. In operation, the semaphore first comes on and changes from the "safety" or green signal to the "danger" or red signal. The locomotive then comes in sight, and it is apparently in motion with revolving wheels, receding track

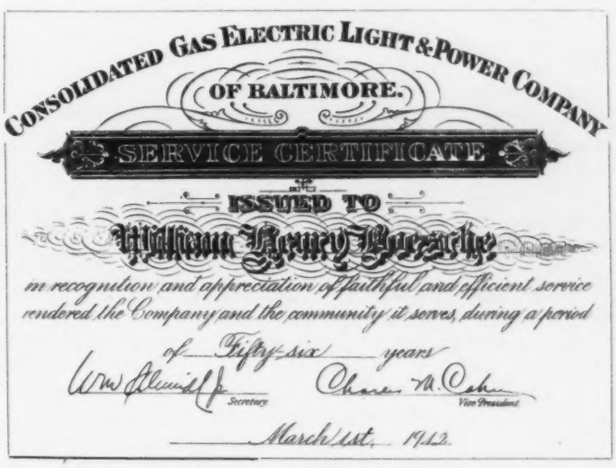


Electric Sign in St. Louis.

and a trail of smoke. The words "Frisco," "to" and "Texas" are then successively turned on. This sign is one of a series of similar nature that are to be erected by the Thomas Cusack Company in various cities along the "Frisco" Railroad. The lettering in the St. Louis sign is about to be changed from "Frisco to Texas" to "Frisco to California," and there will be other changes hereafter.

CENTRAL-STATION SERVICE CERTIFICATE.

In recognition and appreciation of faithful and efficient service rendered by twenty-six of its employees the Consolidated Gas, Electric Light & Power Company, of Baltimore, has issued to each one a service certificate similar


CONSOLIDATED GAS ELECTRIC LIGHT & POWER COMPANY
OF BALTIMORE.
SERVICE CERTIFICATE
ISSUED TO
William Henry Burnside
in recognition and appreciation of faithful and efficient service rendered the Company and the community it serves, during a period
of Fifty-six years
Secretary
Vice President
March 1st, 1912.

Service Certificate for Central-Station Employees.

to the one reproduced herewith. These men retire from the company's service and will be free to obtain other employment if they so desire, but they will receive for the remainder of their lives an annual sum determined by the length of their service and the average of their salaries for the last ten years.

There are three classes of men eligible for retirement under this provision. The first are those who have reached the age of sixty-five and who have been in the company's employ for fifteen years; second, those who have been continuously employed by the company for twenty years and who may have been disabled, and third, those who may have been injured while in the service of the company and who have served with the company for ten years.

The retirement fund is provided entirely by the company and no contributions to it on the part of the employees are required or permitted. The length of service of the first twenty men on the retirement list ranged from fifty-six years down to fifteen years, the average being about thirty-six and one-half years.

PROFITABLE CENTRAL-STATION BUSINESS.

By Ross B. Mateer.

In the past as well as the present much attention has been given by central-station managers to display lighting and attractive signs. The prevailing ideas are that this class of business is the most profitable for central stations to secure. Many articles have been written, and doubtless will continue to be, describing such installations. Some papers devote page after page to exterior lighting and some continually deplore the small amount of money expended for decorative lighting.

That light is a factor in the development of every city and that attractively lighted windows and exteriors stimulate traffic along such thoroughfares as are well lighted is not denied, but in the desire to increase revenues it is questionable if due regard is given to what is the most profitable class of business and worthy of the larger appropriation. Much money is expended for free wiring and for free lamp installations. Additional discounts are often allowed in order that a merchant may be persuaded to place a sign over his shop or that his display windows may be lighted until midnight. The result is a burden far in excess of what the merchant can consistently carry, and an expense that is unreasonable is placed upon the central station merely that "peak-load" business may be secured. The revenue received by the central station is but slightly increased, for the new customer formerly used light for display purposes, but on a meter basis.

Some six or seven years ago the campaign for street lighting began and inducements of all kinds were offered the customer. Signs and window display lighting were secured, but no limit was fixed, and to-day the central station is still following the same tactics, incurring much expense through its contributions to the consumer which the increased business in no way warrants. One may cite any city where a campaign for display lighting began six years ago and after a reasonable period of time, three years, note the business secured; then after another three years make another comparison. Figures speak correctly, and it would be clearly shown that not only does the increased business in no way warrant the free construction expense of the company, but that the number of signs barely exceeds that of the first period of three years.

The central station of not many years ago operated from dusk until midnight or until six in the morning. Banked fires and a silent station characterized the plant during the daylight hours. Yet only a short distance from the silent electric lighting plant a simple engine turned the wheel of a busy manufacturing plant from 7 a. m. until 6 p. m. For years a day load was unknown to the average central station. The result was the rapid increase in steam engines installed for factory and machine drive. The internal-combustion engine was installed in many instances in machine shops and small industries, or in large cities isolated plants were installed in office buildings or for block lighting. Even in factories a generator was belted to the flywheel of the engine used to operate the factory, and central-station service was unheard of so far as day load was concerned. Yet some managements seemed to catch a glimpse of the future and dared to give the consumer twenty-four-hour service.

A motor installed in a building or factory and connected to a central-station company's lines usually remains connected and year after year consumes energy for a period of from three to eight hours a day. The consumption recorded on the meter occurs during the day, when a load is most desired.

Motor load, unlike display or decorative street lighting, is new business or additional, depending on whether the consumer is just persuaded of the value of the electric motor to his industry or whether the power engineer has noticed the customer's needs and increased the output of the factory by additional machinery and motors.

The motor load secured by the central station is the result of patient effort in displacing internal combustion and steam-driven or air-propelled units. In no instance does the load displace existing or profitable central-station business. Motor load is distinctly desirable business and not secured at a sacrifice of existing load, as is the case in the change of a consumer's window lighting from a meter to a flat rate. Seldom is motor load secured by free trials, by incurring wiring expense or by loan or rental of motors. The central station supplies the energy and the consumer furnishes the energy-consuming appliance and the necessary wiring and connections.

Sign or display lighting contracts may be made for a year or two, or, as many examples prove, for a much shorter period, while motor load once secured is continuous. Motor-operated pumps will not be changed back to steam-driven units. The foundry, the mill or the manufactory equipped with small group or individual drive will not be rearranged for the obsolete belt and shaft drive. The abandoned plant will not again be placed in commission where competent power engineers, employed by a central station, are in touch with the consumer. Efforts put forth for motor load are productive of continual and increasing revenues, as the yearly audits of central stations will show.

GRAPHICAL ANALYSIS OF THE ST. LOUIS RESIDENCE RATES.

By Hugo E. Eisenmenger.

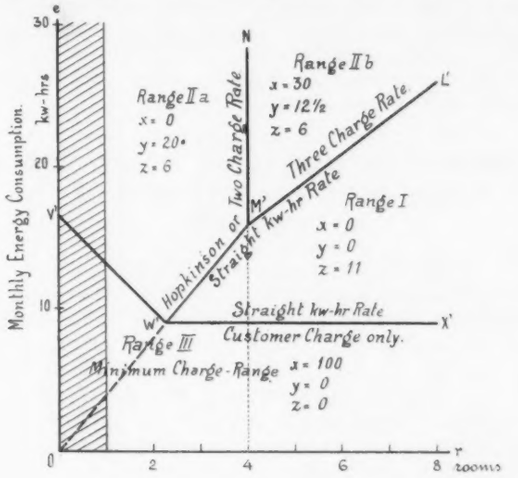
The St. Louis residence rates which were published in the *Electrical World* of Oct. 28 (page 1068) are very interesting for the reason that they furnish an example for the application of three cases of the three-charge rate system, namely: First, a straight meter rate, which means a kw-hour charge, no demand charge, no customer charge; second, a two-charge rate (Hopkinson rate), kw-hour charge and demand charge, no customer charge; third, a three-charge rate, all three charges made. A fourth application is added to this by the introduction of the $1 minimum charge, which means that only a "customer charge" of $1 is made and there is neither a demand nor an energy charge.

Each one of these three (or four) rates applies in a different range. To show this fact the principles laid down in the writer's article on central-station rates in the *Electrical World* of Nov. 4, 1911, will be used to analyze the St. Louis rates in the manner shown therein.

Since the "maximum demand" in this schedule of rates is not determined as the actual maximum demand in kilowatts, but as an equivalent (number of active rooms), the unit of the scale of the axis "D" (maximum demand) will have to be "number of rooms" and not "kilowatts." For the same reason there is no representation of the load-factor and, therefore, one cannot speak of a certain portion being cut off by the 100 per cent load-factor. For obvious

reasons, however, that part of the system of co-ordinates which would correspond to a "maximum demand" of less than one room will be without practical significance and is, therefore, shaded in Figs. 1 and 2.

According to the schedule there is a multiple rate with a primary charge of 11 cents per kw-hour and a secondary



x = equivalent customer charge in cents per customer per month.
y = " " demand " " " " room per month.
z = " " kw-hr " " " " kw-hr.

Fig. 1—Ranges of Three Different Kinds of Rates.

of 6 cents per kw-hour. The primary charge applies until an energy consumption is reached which (in kw-hours as unit) equals four times the number of rooms, up to a number of four "active" rooms; if the number of rooms is greater than four, then 2.5 kw-hours for every additional room is added to that energy consumption in order to ascertain the number of kw-hours for which the primary rate applies. That part of the customer's kw-hour consumption which exceeds those amounts of kw-hours is charged at the secondary rate of 6 cents per kw-hour.

There exists, therefore, the rather unique case[1] that the dividing line between the primary and secondary range is not straight, but is broken, as shown by $OM'L'$ in Fig. 1.

If the number of rooms be designated by r, then the equation of the dividing line between primary and secondary range up to four rooms OM' is:

$$e = 4r. \qquad (a)$$

where e is the monthly energy consumption in kw-hours. For all values of r larger than 4 the equation of the dividing line $M'L'$ is:

$$e = (4 \times 4) + 2.5\,(r - 4) = 6 + 2.5\,r. \qquad (b)$$

The amount of the customer's monthly bill will, therefore, be:

I. If the customer does not reach the secondary charge:

$$a = 11\,e \qquad (1)$$

(Range I, $rOM'L'$, Fig. 1, straight kw-hour rate.)

II. If the customer reaches the secondary rate:

(a) Number of rooms equal to or below four:

$$a = 11 \times 4\,r + 6\,(e - 4\,r) = 20\,r + 6\,e \qquad (2)$$

This means a demand charge of 20 cents per room and an energy charge of 6 cents per kw-hour. (Range IIa, $eOM'N'$, Fig. 1.)

(b) Number of rooms equal to or above four:

$$a = 11\,(6 + 2.5\,r) + 6\,[e - (6 + 2.5\,r)]$$
$$= 30 + 12.5\,r + 6\,e. \qquad (3)$$

In this range (IIb, $N'M'L'$, in Fig. 1) there are a customer charge of 30 cents per customer per month, a demand charge of 12.5 cents per active room per month and an energy charge of 6 cents per kw-hour.

[1]The same general method of fixing number of kw-hours at the primary rate is used by The Milwaukee Electric Railway & Light Company in its residential lighting service.

Fig. 2 shows the same results from a geometrical point of view. Plane $OBMCD$ represents the straight kw-hour rate of 11 cents, which applies in the primary range. There are also the two-charge (Hopkinson) plane corresponding to equation (2) shown by $OEMNAF$ and, finally, the three-charge plane, equation (3), $GHNMILK$.

The $1 minimum charge is brought in by the horizontal plane $RSTU$, which introduces the step $RVWXU$ (Fig. 2) in the range $OV'W'X'r$ (Fig. 1) taken away from the areas, which without that minimum charge would belong partly to Range I and partly to Range IIa.

The resulting model then is the thickly outlined solid in Fig. 2, and the bottom plane in that figure shows the ranges of the three different kinds of rate in dash and dot lines. These three ranges are also shown in Fig. 1, which represents the bottom plane of the model.

In Range I (see Fig. 1) neither customer charges nor demand charges are made, only an energy charge of 11 cents per kw-hour. In Range IIa no customer charge is made, but there are a demand charge of 20 cents per room and an energy charge of 6 cents per kw-hour, and in Range IIb all three charges are made, the customer charge having an amount of 30 cents per customer per month, the demand charge amounting to 12.5 cents per active room per month and the energy charge to 6 cents per kw-hour. In Range III (range of the $1 minimum) there is a customer charge of $1 per month, but neither a demand nor a kw-hour charge.

Referring to Fig. 2, the energy charge and demand charge

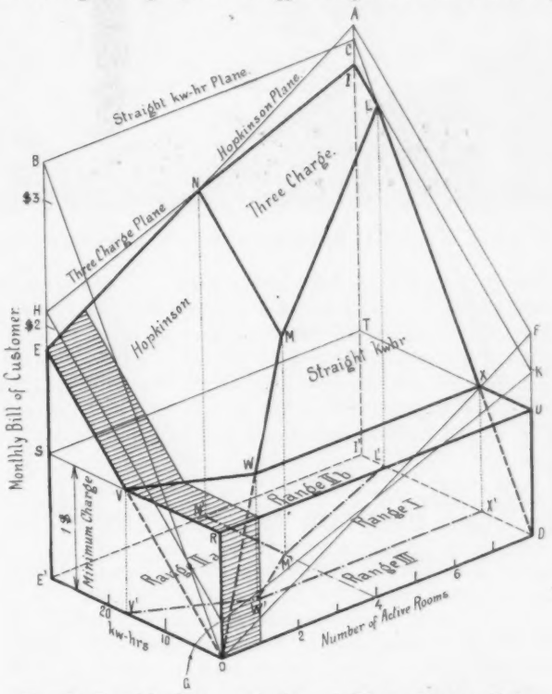


Fig. 2—Graphic Representation of Three-Charge Rate.

are represented by the slope of the traces of the plane of rates on the planes of co-ordinates; the customer charges of Ranges IIb and III are represented by the lengths OG and OR respectively.

RECORD BOILER EFFICIENCIES OBTAINED BY IMPROVED BAFFLING.

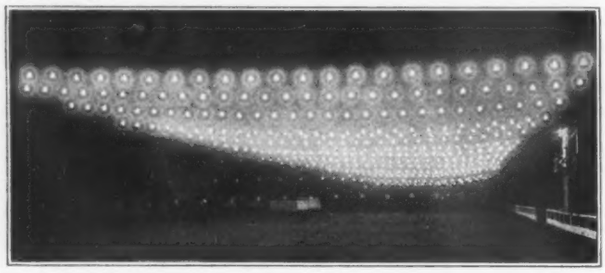
Recent rough tests conducted on several 500-hp Stirling boilers in the Delray generating station of the Detroit Edison Company reveal that by making changes in the combustion chambers and baffling the efficiency of these units, heretofore limited to about 73 per cent, can be raised to 80 per cent, or the equal of that of the 2300-hp boilers. In

the case of the small boilers experimented upon the arches were removed, leaving combustion chambers of increased size. Baffling applied to the initial pass then directs the hot gases longitudinally down the nest of tubes, while the final traverse of the rear tubes is converted into a double pass. The result is an increase in gas velocities and the lowering of flue temperatures. A similar change of baffling is planned for the huge 2300-hp boilers at Delray, from which steam outputs of 7000 kw to 11,000 kw have been drawn. As reported in these columns, these big boilers showed test efficiencies of 81 per cent with bituminous fuel, and by improved baffling it is hoped to increase this figure to 85 per cent.

Wiring and Illumination

OUTDOOR ILLUMINATION FOR A HORSE SHOW.

Some time ago a horse show was held at the county fair grounds at Springfield, Ohio, and as several of the events extended over into the evening, illumination of the track in front of the grand stand was required. The Springfield Light, Heat & Power Company extended its lines half a mile to the grounds, carrying part of this temporary construction on tree brackets. Across the track were strung



Illumination in Front of Grand Stand at Springfield Horse Show.

700 16-cp lamps in prismatic reflectors, as shown in the accompanying illustration, providing ample illumination for all events. The cost of this temporary installation was defrayed by the horse show association, which also paid for the energy consumed. The latter cost was, however, slight for the two nights the lighting was in use, and the installation proved a good advertisement for the electric company.

ODD USES FOR ELECTRIC LAMPS.

In the new café of the Boody Hotel, Toledo, a row of fifteen frosted-ball lamps is mounted over the entrance doorway. Each lamp bears a number corresponding to those of the waiters on duty. After delivering his order to the chief, the waiter is instructed to return at once to his dining-room station. Then as soon as the food is prepared the kitchen serving-man closes the corresponding switch, lighting the numbered lamp in the dining-room and calling the waiter. This system keeps the waiters in the dining-room, where they can give attention to other guests, and yet causes no delay in prompt service of orders when ready. The position of the lamps enables the waiters to watch for the entrance of guests while awaiting their signals. In the brightly lighted interior the operation of the call lamps is not obtrusive, although the numbers can be read from any part of the room.

A Chicago restaurant proprietor uses a home-made electrically heated humidor to keep his cigars in good condition. A tin box is filled with water, and into this is dipped the bulb of a 16-cp carbon lamp to promote evaporation. The lamp helps in the general lighting of the showcase, although its design could doubtless be improved so that the illumination would be efficient while the waste heat is used for warming the water.

The operator of a moving-picture theater in Ann Arbor, Mich., has inserted lamps and reflectors in the aisle sides of the raised steps on which the rows of seats are mounted. All of the light is thus projected on the aisle floor, illuminating it to the considerable convenience of persons entering from the brightly lighted exterior, although causing no annoyance to the seated audience. Several lamps under aisle seats would accomplish the same result when there are no raised steps to conceal the units.

THE EFFECT OF HEIGHT OF SUSPENSION OF LAMPS UPON THE INTENSITY OF ILLUMINATION.

By W. E. Barrows, Jr.

The fact that the intensity of illumination due to a point source of light varies inversely as the square of the distance between the source of light and the surface illuminated is familiar to all, but the significance and the practical application of the relationship existing between the distance from an infinite linear source or an infinite surface source and the intensity of ilumination resulting therefrom are realized only by those most vitally interested in or intimately associated with the theory or uses of light.

It has been demonstrated by numerous investigators, and it can be shown mathematically, that the illumination at a given point in a normal plane due to a tubular source of infinite length varies inversely as the distance from the source to the point illuminated and not inversely as the square of the distance, as in the case of a point source. It is also well established that the illumination at a point on a normal plane due to an infinite surface source is quite independent of the distance between the point and the source.

It is obvious that luminous sources having infinite dimensions are merely theoretical, but it is interesting to assume certain practical conditions and learn how approximately the infinite dimension relationship may apply in practice. For this purpose the writer has chosen the 100-watt tungsten unit equipped with the intensive type of high-efficiency reflector. This type of reflector is so designed that when it is used with the proper lamp and the units are properly placed approximately uniform illumination on the working plant will be obtained.

The distribution of light in a vertical plane through the axis of this type of lighting equipment is shown in Fig. 1. This polar candle-power curve shows only the intensity of the light in different directions in a vertical plane and gives no clew as to the resulting illumination. The illumination due to one lamp placed 8 ft. above the reference plane is indicated by curve *a* of Fig. 2. If two lamps are placed 10 ft. apart and 8 ft. above the plane, the illumination along a line beneath the two lamps will be approximately uniform, as indicated by curve *b* of Fig. 2. With a distance of 10 ft. between lamps, 8 ft. is the minimum height of suspension which will secure approximately uniform illumination. The two lamps can be placed at greater heights with the same spacing without impairing the uniformity of illumination, although the intensity of illumination will be lower.

To investigate the effect of the height of suspension of lamps above the plane illuminated the writer has assumed a room 50 ft. by 50 ft. in area and lighted by the equipment just described. The lamps are placed, according to common practice, at centers of equal areas, each 10 ft. square in this case, as shown in Fig. 3. The reflections from walls and ceiling are neglected, and the results are calculated from the polar candle-power curve of Fig. 1 by the point-by-point method employing the well-known equation:

$$\beta_h = \frac{C_a \cos^3 a}{h^2}$$

where β_h is the intensity of illumination on the reference plane in foot-candles; C_a, the candle-power a deg. from the vertical; h, the height of the lamps above the reference plane in feet.

The illumination at the center on the room was determined for three conditions: First, due to one lamp (No. 13) which may be considered a point source; second, due to a

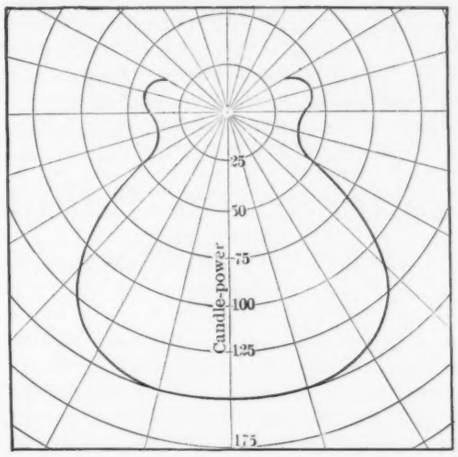


Fig. 1—The Intensive Type of Polar Candle-Power Curve.

row of lamps (11 to 15, inclusive), and, third, due to all of the twenty-five lamps.

The results thus calculated with the lamps at different heights are represented graphically in Fig. 4, together with those for the theoretical infinite linear and surface sources. The minimum height is 8 ft., the least height permissible for uniform illumination with a spacing of 10 ft. between the particular lighting units selected. The uniformity of illumination is approximately the same for all heights from 8 ft. to 20 ft. In Fig. 4 the illumination is expressed in per cent of that at a height of 8 ft. Curve a simply represents the case of one lamp or a point source; the illumination varies in accordance with the inverse square law. Curve b indicates the variation in intensity due to the row of five lamps, showing a considerable departure from the inverse square law but not a very great difference from the theoretical infinite tubular source represented by curve c, which is plotted with illumination varying inversely as the height of suspension. Curve d represents the intensities due to the twenty-five lamps and curve e the ideal case of an infinite surface source.

In interpreting these results it must be borne in mind

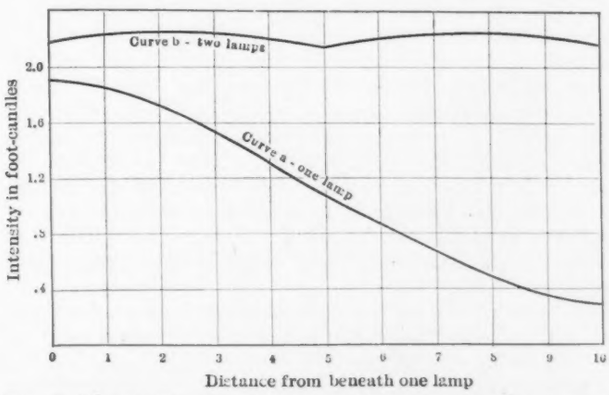


Fig. 2—Illumination Due to One and Two Lamps Placed 8 ft. Above the Plane Illuminated.

that the lamps have been raised from 8 ft. to 20 ft., or through a distance of 12 ft., and no correction has been made for reflection from walls and ceiling. These curves thus represent the maximum decrease that may be expected even with dark walls and ceiling. The decrease in intensity of illumination when the lamps are uniformly distributed and are raised to a greater height is obviously due to a greater part of the light passing to the walls and ceiling. If the walls and ceiling are white in color, about

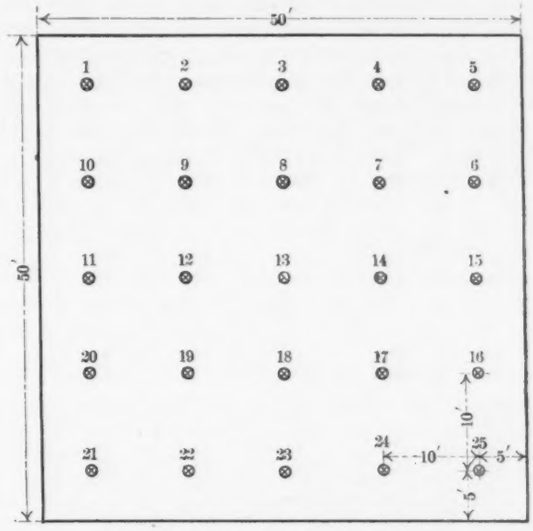


Fig. 3—Location of Lamps in Room.

70 per cent of the light thus apparently lost will be returned to the reference plane and will greatly reduce the difference between curves d and e. The same line of reasoning will apply to some extent to the other cases as well. Moreover, a little thought will make it clear that as the lamps are raised the rays passing to the walls and ceiling strike those surfaces at angles which are more effective in throwing this light on to the working plane.

This article was prompted by the feeling that many mistakes are continually being made in the lighting of large rooms by locating the lamps too low. There appears to be an insistence among those "who know not, but think they know," that the proper heights at which to locate the lamps of an installation is between 10 and 12 ft. above the floor, irrespective of the size of the room, height of ceiling, class of service or condition of the surroundings. In a large room with the lamps placed at this height the sources of light are only a little above the line of vision and shine

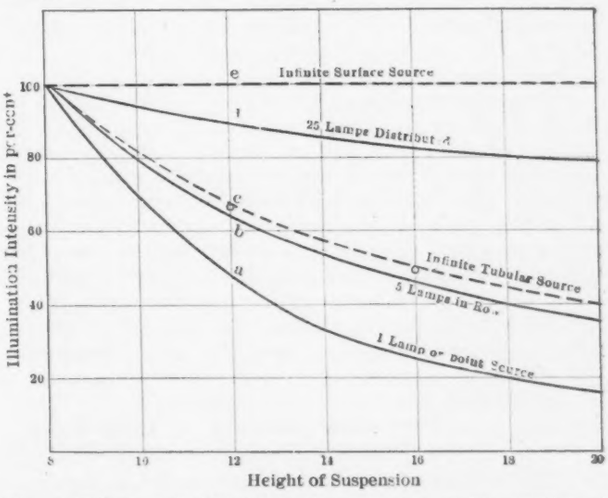


Fig. 4—Effect of Height Upon the Intensity of Illumination at Center of Room.

into the eyes of the individual observing objects around the room. In this way the pupil of the eye is contracted and the illumination is less effective and less satisfactory than when lamps are placed higher and out of the range of vision, although the intensity may be several per cent less.

RECENT TELEPHONE PATENTS.

PARTY-LINE SYSTEMS AND APPARATUS.

The party line is still the subject of much work on the part of inventors, their efforts being fairly well divided between the selective system and the rural-line step-by-step systems. There are a number of successful systems of the selective type in use. In the latter, however, the need of adjustable apparatus scattered along a considerable length of line arises. Again, the requirements for operation of the selective type are fairly well standardized. For the rural systems this is not the case, and various systems have been devised to meet the inventor's idea of the most desirable system of operation. This is evidenced in a patent recently granted to Mr. F. E. Granger, of Aberdeen, S. D., for a step-by-step selective system. It is desired to provide for private conversation without locking out the parties to it as is done upon many systems. To each station a dial is given, all of these dials following synchronously the switches of the last station coming in on the line. Thus, if a conversation exists, any interloper must manipulate his apparatus so that the dials at all stations show that he is connected and who he is. Each station has also a selector device, all of these operating in unison, step by step, and different angular displacements correspond to the different stations of the line. This part of the apparatus serves for the selection of the desired station for an incoming call.

Another of these systems is patented by Mr. D. W. Kneisly, of Dayton, Ohio, his patent being assigned to the Dayton Telephone Lockout Manufacturing Company. This is also a step-by-step system, but here all save the desired stations are positively locked out from the line. The selectors at all stations are stepped off normal during a call. All are simultaneously released at the termination of the call by a reversed-current impulse which the operator must send out upon the line.

A selective system is patented by Mr. W. A. Fricke, of Chicago, the patent having been assigned to the Monarch Telephone Manufacturing Company. This system contemplates four stations. One is rung by positive direct current, the station having a properly poled direct-current polarized bell with break contact. One responds to negative current, being oppositely poled. A third is connected to ground from the middle of an impedance. This impedance is bridged across the line. The bell responds to direct current connected to one side of the line, the battery being grounded by the ringing key. The fourth station has an alternating-current bell with a condenser in series. The current is furnished from an alternating-current source.

A fourth patent relating to ringing is that obtained by Mr. W. E. Butler, of David City, Neb., and covering a pole-changer for furnishing ringing currents. Mr. Butler has devised several forms of mercury contacts which he employs. The vibrating arm of the pole-changer causes the points alternately to dip into and to be withdrawn from the mercury cups. In one form oil is poured on top of the mercury to prevent sparking and oxidation, the contact and break taking place below the oil. In a second type a double chamber is used, the dividing wall being low. An insulating point is mounted to dip into one or both cup compartments. The circuit is from one cup compartment to the other. When the point dips, the mercury overflows the low partition and closes the circuit. As the level lowers a break occurs, but it is a mercury break with practically fresh material each stroke.

REPEATERS.

Mr. C. Adams-Randall, of New York City, has obtained several additional patents for repeater circuits and systems. Probably the simplest uses a single repeater and repeating induction coil. The receiving windings of the repeater are cut into one side of the telephone line, while the secondary of the repeating induction coil is cut into the other side of the line in series. The repeater transmitter is connected to the primary of the induction coil. Currents from either station energize the repeater magnet, which in turn operates the repeating transmitter and through its induction coil sends out upon the line similar and magnified currents.

In another arrangement the repeater local circuit and one side of the line are carried through the two sets of contacts of a relay so as to be normally open. This relay is controlled by a second relay which responds to the receiver hook at one end of the line. The repeater battery is not wasted with such an arrangement. According to the system described in the third patent, two repeaters are used, arranged for service in opposite directions.

Letter to the Editor

INJUSTICE TO INVENTORS.

To the Editor of Electrical World:

Sir:—I notice in your issue of March 9 a communication from Mr. Edward P. Thompson in which he tells how small inventions are sold for a mere pittance to big manufacturers and how successful inventors do not sell their patent rights immediately, but form a company, etc.

This method has probably worked in the past and no doubt will still work in a few cases, but Mr. Thompson has entirely overlooked one tendency which is growing to serious proportions, namely, that of the government giving a man a patent right and then taking it away from him again after he has spent much money in working up a company and a business.

Let me explain how this works. On a certain date the government allows, through the Patent Office, a letter patent on a device. The inventor forms his company and builds up a business. About that time along comes a big manufacturer who sees the value of the device and, after finding that he is unable to persuade the inventor to sell his patent for the amount he has already spent in advertising and forming his company or a little more, the manufacturer rearranges the parts of the device and drafts a new design of the same invention. Taking this to Washington, he usually succeeds in railroading his patent through the Patent Office. Thus the government, through the instrumentality of the patent examiner, takes away the patent which it has issued to one man and hands it over to another. It seems to me that each one who has had anything to do with the development of a device should get some reward for his efforts. As it is, the last man on the job gets all and the one who is responsible for the fundamental idea around which all later improvements hinge and without which the device would never have appeared gets nothing.

If the above plan of the manufacturer fails, he simply infringes upon the patent, knowing that the average inventor has no means wherewith to carry out a lawsuit, even assuming that justice would be dealt out to him. In case suit follows, the litigation is drawn out to such an extent that the inventor dies of old age or the manufacturer makes a good pile out of the infringement and is willing to let go. All that I have said above is based upon cases actually observed and is not due to the imagination.

In view of the injustice of the present patent laws and of their administration by the courts, what can a poor inventor do but sell for whatever he can get?

One more point is worth mentioning. If the manufacturer ever pays the right price for a patent, why is it that one of the greatest inventors the world has ever known, Thomas A. Edison, is so often heard from on this very topic? It can be safely said that if an inventor has brains enough to invent he in all probability also has enough to dispose of his invention in the most profitable manner.

Fort Madison, Ia. W. M. Stempel.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

[*For the convenience of readers who file clippings from the Digest, the year of issue is now added to the date printed at the end of abstracts.*]

Generators, Motors and Transformers.

Rotary Rectifier.—A. SOULIER.—An article on a rotary rectifier of French design, which has been noticed briefly before in the *Digest*. It is an apparatus for converting single-phase current into continuous current, in which the pressure on the continuous-current side can be varied at will from zero to a maximum without affecting the single-phase pressure. The principle is shown in Fig. 1. The machine consists of a ring, *A*, composed of fine insulated iron stampings, on which are placed two coils, *BDC* and *BEC*, wound in opposite directions. These two windings, supplied at *B* and *C* with single-phase current, produce a magnetic field of which the circuit is completely closed. The windings are arranged in the form of a Gramme ring, in sections, the ends of which are connected to the segments of a commutator, *F*. The ring and commutator are driven by means of a synchronous motor connected to the single-phase supply and single-phase current is led into the points *B* and *C* by means of slip-rings. Brushes G_1 and G_2 are fixed diametrically opposite one another. If the position of the brushes is such that they pass before the points *B* and *C* at the instant when the alternating pressure is a maximum, the potential difference between G_1 and G_2 will always have the same direction but will pulsate. The mean value of the pressure between G_1 and G_2 is $4E_0 \div \pi^2$, where E_0 is the maximum value of the alternating pressure. This is the principle of the machine, but it is possible to arrange it in another way to obtain better results. The commutator *F*, instead of being made of segments insulated from each other, is divided into several groups of segments 1, 2, 3, 4 (Fig. 2). The segments of groups 1 and 3 are insulated from each other and connected to the sections of the windings, but the segments of groups 2 and 4 are not insulated from each other, and are connected to the points *B* and *C*, and therefore to the slip-rings. Hence the brushes are directly connected to the single-phase supply while they are passing over groups 2 and 4, and the windings play an active part only while the brushes are in contact with groups 1 and 3. With this arrangement only half the ring is covered by windings, and the other half may be wound and connected in a similar way to another similar commutator symmetrically placed. Rectifiers can be made with two, four or six lines of brushes as easily as a continuous-current generator, and in this way it is possible to obtain large outputs and very high efficiencies. To vary the pressure at the brushes it is necessary merely to shift all the brushes corresponding to one polarity of the machine. The curve in Fig. 3 shows how the continuous pressure varies according to the position of the brushes, where the angle *a* (which represents the abscissas) is the angle G_1OB in Fig. 2. If the brushes G_1G_2 are closed on a non-inductive power circuit, there is produced a pulsating current having the same wave-shape as the rectified pressure. If, however, a choking coil is connected in series, the pulsations are smothered out, and for all practical purposes the rectified current can be considered perfectly continuous. Every oscillation of the synchronous motor produces the same effect on the pressure at the brushes as if the brushes were shifted an amount corresponding to the oscillation. It is, therefore, necessary to suppress absolutely all oscillations of the motor. If the plant consists of two rectifiers driven by separate motors, the commutators being connected in series, it is easy to do this. It is necessary merely to drive the rectifiers in opposite directions, to shift the brushes in the same direction, and to make the motors always oscillate in the same way. Then an oscillation of the motors will have the effect of increasing the pressure at the brushes of one rectifier and decreasing it for the other, so that the sum of the variations is zero. To make the motors oscillate in the

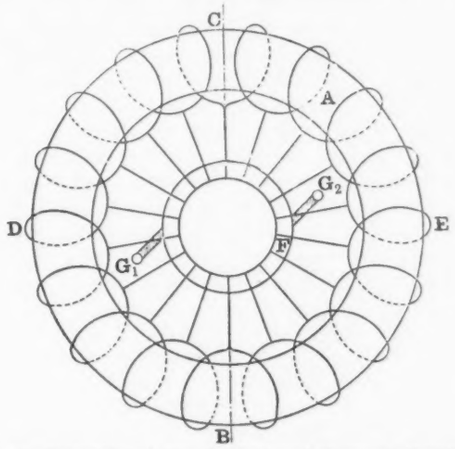


Fig. 1—Principle of the Auvert and Ferrand Rectifier.

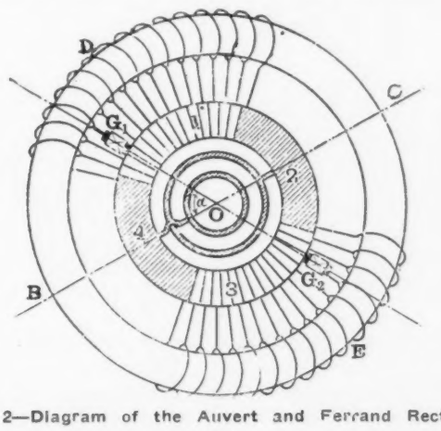


Fig. 2—Diagram of the Auvert and Ferrand Rectifier.

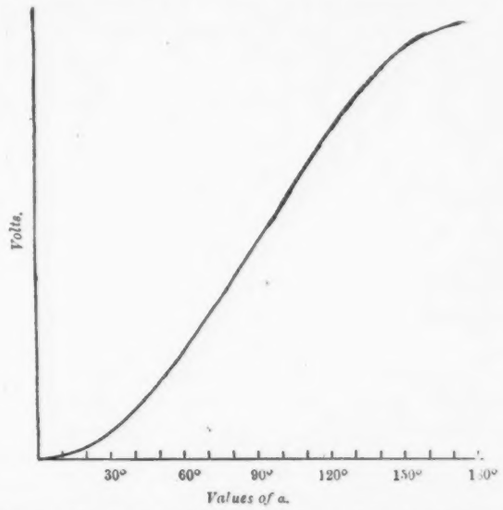


Fig. 3—Effect of Shifting Brushes on Rectified Pressure.

same way, it is sufficient to connect three points of the armature of one motor, 120 deg. apart, to the corresponding points of the other. The three-phase connection thus formed is as rigid as a mechanical coupling. An account is given of some tests of this arrangement of two rectifiers running in opposite directions on a locomotive, the emf of the alternating current on the trolley line being 12,000 volts. It was established in these tests that there is no sudden rush of current at starting, and yet the acceleration is high. The power supplied by the central station is very small at starting, and increases according to the mechanical power developed. This is due to the fact that the pressure of the rectifier is almost zero at starting. The experiments were made on a line of 7.3 km (4.5 miles), starting from the station at Grasse. From the station to the axles the overall efficiency of the system was found to vary between 0.78 and 0.80 at full load. The tests were insufficient, however, to determine the heating of the machines.—London *Electrician*, March 1, 1912.

Transformers.—Henry.—Continuation and conclusion of his long serial giving notes on stationary transformers. The author deals with the heating of transformers and methods of cooling and concludes with some general remarks on the choice of a transformer and data on transformers concerning efficiency and robustness.—*L'Industrie Elec.*, Feb. 10 and 25, 1912.

Carbon Brushes.—W. R. Whitney.—An illustrated Franklin Institute paper giving details of the testing and manufacturing of carbon brushes. The different steps in manufacture, the grinding and mixing of the ingredients (fine grinding being very important), the pressing of the brushes, and the process of baking (which also requires great care) are described in some detail. Special reference is made to railway motor brushes.—*Journal Frank'in Institute*, March, 1912.

Lamps and Lighting.

Condensers on Lighting Circuits.—A. W. Ashton.—An article illustrated by diagrams giving an outline of the theory of the use of condensers on alternating-current lighting circuits. Both the applications of the series system and of the parallel system are described. The use of condensers was first proposed because low-candle-power lamps were then not available for 250-volt circuits. Although such lamps are now in the market, it is still economical to use 25-volt or 50-volt lamps in series with condensers. The advantages are as follows: The condenser prevents damage to the filament due to the initial rush of current when switching on. The low-voltage lamp, having a comparatively short thick drawn-wire filament, can be handled without fear of breakage. The blackening due to deposit of the metal on the bulb, caused by electric discharge between the legs of the filament, is much less with a low-voltage than with a high-voltage lamp.—London *Elec. Review*, March 1, 1912.

Metallic-Filament Lamps.—Marchand.—An article on some applications of metallic-filament lamps. The accompanying table shows the sizes of Osram lamps used in 489 German central stations employing a total of 33,643 Osram lamps:

SIZES OF OSRAM LAMPS USED IN GERMAN CENTRAL STATIONS.

	Candle-Power.											
	16	25	32	40	50	70	100	200	300	400	600	1000
Number o lamps	636	3319	6615	695	20,325	285	1379	135	81	113	56	5
Per cent of total lamps	1.9	10.0	20.0	2.1	60.0	0.8	4.0	0.4	0.2	0.3	0.1	0.02

It will be seen that the size most in favor is the 50-cp lamp. Tables are added giving data on the comparative cost of lighting with carbon lamps and metallic-filament lamps.—*L'Industrie Elec.*, Feb. 10, 1912.

Electric Lighting of Automobiles.—A. Soulier.—A review of the different methods of electric lighting of automobiles, with diagrams of the principal generators devised for this purpose. These are the Inglesis-Regner generator, the Phi or Blériot generator, the Grob generator (which operate with full regulation), the Rosenberg generator, the Vandervell generator, the Leitner generator and the Trier-Martin generator (utilizing the armature reaction), and the Lucas system, in which the generator is run at constant speed by means of a mechanical speed-changing gear. The author emphasizes the point that for the electric lighting of automobiles the simplest solution will be the best.—*L'Industrie Elec.*, Feb. 25, 1912.

Generation, Transmission and Distribution.

Winnipeg.—The first part of an illustrated description of the hydroelectric power scheme of the city of Winnipeg. The system now completed consists of a 30,000-hp hydroelectric plant operated under a 45-ft. head (this is to be enlarged to 60,000 hp); a 77-mile, 60-cycle, 72,000-volt transmission system consisting of one double-circuit steel-tower line with concrete foundations; a terminal station in the city, at which the transmission-line pressure is reduced to 12,000 volts; an underground 12,000-volt distribution to substations, and two substations where the emf is reduced to 2200 volts alternating current and 550 volts direct current.—London *Electrician*, March 1, 1912.

Operation in Parallel.—K. Czeija.—An article illustrated by diagrams discussing the general principles according to which the electrical designer, the prime-mover designer and the central-station manager must co-operate to obtain satisfactory working in parallel. In the present instalment the author discusses the choice of the momentum, the conditions to be fulfilled in the design of the prime-mover, means for improving parallel operation of existing machines and the operation in parallel of different types of generating sets.—*Elek. Zeit.*, Feb. 29, 1912.

Electricity in Iron Mines.—An illustrated article on the Sydvaranger iron mines in Norway, describing the use of electric power in the mines and the application of the Gröndal magnetic separation system.—London *Elec. Rev.*, March 1, 1912.

Long-Distance Gas-Transmission Lines.—B. Buhk.—An illustrated article in which the author gives an account of the troubles experienced along the Hamburg long-distance gas-transmission line from Bergedorf to Geesthacht. The effect on trees in the neighborhood has been destructive. After three years of operation of the gas-transmission line, out of 320 trees not less than 66, that is 20 per cent, have died.—*Elek. Zeit.*, Feb. 29, 1912.

Traction.

Omnibus Driving.—J. C. MacFarlane and H. Burge.—The conclusion of their illustrated paper on the supply and transmission of power in self-contained road vehicles and locomotives. In the present instalment the authors take up the discussion of gasoline-electric omnibuses and also deal with the possibility of using an oil-engine-electric system on suburban lines and branch lines of existing steam railroads in cases where complete electrification would be impracticable or too expensive.—London *Electrician*, March 1, 1912.

Installations, Systems and Appliances.

Central Station Statistics.—L. Rosenbaum.—A summary of some of the results of the statistics for 1909 of the Union of Central Stations (Vereinigung der Elektricitätswerke), relating to 327 central stations in different European countries. The average connections per 1000 inhabitants in cities with less than 2000 population were 87.3 kw; in cities from 10,000 to 50,000 population, 78.7 kw; in cities from 20,000 to 50,000 population, 63.8 kw; in cities from 50,000 to 100,000 population, 56 kw, and in cities with a

population above 100,000 they were 82.2 kw. Hence in cities of medium size (20,000 to 100,000 inhabitants) the connections are considerably less than in small cities and in large cities. This is especially true for lighting. The same result is shown in the central-station statistics of Germany and of Austria. The explanation is found in the competition of gas plants. The average consumption of kilowatt-hours per inhabitant for lighting, motor service and traction and the total consumption in cities of different sizes is given in the accompanying table:

KILOWATT-HOURS PER INHABITANT.

Inhabitants.	Lighting.	Motor Service.	Traction.	Total.
Under 10,000	14.9	13.5	....	28.4
10,000 to 20,000	11.2	13.7	2.9	27.8
20,000 to 50,000	7.9	8.9	7.1	24.0
50,000 to 100,000	6.7	8.3	8.2	23.2
Above 100,000	10.2	12.3	12.0	34.5

The total consumption in kilowatt-hours per inhabitant, including traction, is, therefore, not very different in cities of different sizes. Tables on cost of operation, receipts, net earnings, etc., are added. In all works in which the cost of operation is below 2.5 cents per kw-hr. the addition of a traction load has been financially beneficial, while the reverse is true in stations with a higher cost of operation. In general a reduction of the rates for lighting has by no means a bad effect on the net earnings. A flat rate for lighting and free renewal of incandescent lamps are beneficial in competition with gas plants.—*Elek. u. Masch.* (Vienna), Feb. 25, 1912.

Rate Schedule.—NORBERG-SCHULZ.—A critical discussion of various rates for energy which are based on a combination of flat rate and meter. For instance, in Christiania three different rates are in use. Private consumers can buy the energy at a flat rate, the consumption being limited by watt-limiting devices. Further, the consumers may rent meters and may switch over the whole consumption to the meter. Small consumers with installations of not more than six lamps for not more than 300 watts are allowed a flat rate, but the station may install control apparatus and it is proposed to install limiting devices in this case too. The third tariff is increasing in favor more than the other two. Some critical discussions on rates of this kind are added.—*Elek. Zeit.*, Feb. 29, 1912.

Elevators.—An illustrated description of various European systems of elevators with button control. Six different systems are described and illustrated by diagrams. —*L'Industrie Elec.*, Feb. 10, 1912.

Wires, Wiring and Conduits.

Characteristic Curves for Artificial Insulating Materials. —E. KNOBLAUCH.—The author proposes to indicate the quality of certain artificial insulating materials by a curve as follows: The more expensive materials include those possessing good insulating and binding qualities, while the cheaper classes contain fewer binding materials but are more reverberatory. The author proposes to designate consecutively the different compositions of such an insulating material by *A, B, C,* etc., where *A* is the poorest quality, and to plot these qualities *A, B, C* as abscissas of a diagram. As ordinates the perforation voltage is plotted for the different qualities. A curve is thus obtained giving directly the perforation voltage for *A, B, C,* etc. At the different points A_1 . . . of the curve the author proposes to enter also figures of the hygroscopic qualities, the refractoriness, etc.—*Elek. Zeit.*, Feb. 29, 1912.

Flexible Cable.—A note on a recent British patent (No. 3996, Feb. 22, 1912) of H. Evans and St. Helen's Cable & Rubber Company, Ltd., for a flexible cable, single or multicored, suitable for use where it is subject to damp, abrasion, rough handling and similar unfavorable conditions. The separate insulated conductors are covered with a special rubber preparation as follows: 50 per cent rubber and 50 per cent of a hardened material, such as silica or balata, and similar to that from which cab tires are made. It can be put on the cable in a plastic state. The cable is drawn through a tube, concentric with which and surrounding it is a cylinder closed at one end and containing a die at the other slightly smaller than the tube. The cylinder is fed at the side through a tube containing a rotating screw which forces the rubber preparation into the cylinder, and the pressure, which increases at the narrow annular space by the die, is sufficient to force the preparation into the interstices of the cable. The cable issues completely covered with the preparation, which only requires vulcanizing. —London *Elec. Eng'ing*, Feb. 29, 1912.

Frost and Telegraph Cables.—An illustrated article on the break-down of two dry-core telegraph cables on a British telegraph line. The two cables were laid in a 4-in. cast-iron pipe into which water found its way, and the cable was so deformed by the ice forming round it as to become faulty. The illustrations show that the effect of the ice was not only to compress but to distort the cable.—London *Electrician*, March 1, 1912.

Preservation of Wooden Poles.—SEIDENSCHNUR.—The conclusion of his illustrated paper on methods of preserving wooden poles by impregnation. In the present instalment the author deals especially with the use of tar oil.—*Elek. Zeit.*, Feb. 29, 1912.

Electrophysics and Magnetism.

Electron Theory of Contact Electromotive Force and Thermoelectricity.—O. W. RICHARDSON.—A theoretical paper in which the author deduces certain formulas which connect some of the physical properties of conductors, particularly in the domain of thermoelectricity, with the number and state of the free electrons present in them. The author's theory is a natural development of the results of his investigation of the emission of negative electrons from hot bodies. The method is based on two fundamental assumptions. The first, which is common to all forms of the electron theory of metallic conduction, is that the electric current in metals is carried by electrons which move about freely, exert a pressure and are otherwise dynamically equivalent to the molecules of a gas. The second is that the potential energy of an electron is much less when it is inside an uncharged conductor than when it is extracted and removed to a considerable distance. It follows that a definite amount of work has to be done by an electron before it can escape from a conductor, and it is the force at the interface, which corresponds to this amount of work, which retains the electrons in the conductor at ordinary temperatures.—*Phil. Mag.*, March, 1912.

Ionization in Gaseous Mixtures by Röntgen Radiation.— C. G. BARKLA AND L. SIMONS.—An account of experiments on the ionization of gaseous mixtures by homogeneous beams of X-rays. The chief results are as follows: Equal absorptions of X-rays and of their secondary rays by different gases are not always accompanied by equal ionizations, though as a rule the deviation from proportionality is not great. Equal absorptions of corpuscular (electronic) radiation by different gases are not always accompanied by equal ionizations. The relative ionizations produced by equal absorptions of X-rays in the gases experimented upon are, within small errors of experiment, the same as those produced by the corpuscular radiation excited by the X-rays. The results thus point to the possibility of the relative ionizations in different gases due to the total absorption of X-radiation being identical with those due to corpuscular (electronic) radiation and alpha radiation. Preliminary experiments appear to indicate—though the results may not be accepted as conclusive—that much of the ionization by X-rays is not due to the secondary corpuscular radiation. Further experiments on these lines will probably give the most direct answer to the question

as to the part played by secondary rays in the process of ionization.—*Phil. Mag.*, March, 1912.

Free Electrons in Metal.—D. Owen.—A review of the present theories on free electrons in metals with applications to the electric conduction in a metal, the thermal conductivity and its relation to electrical conductivity, and the emission of electrons from metals caused by light or heat.—London *Electrician*, March 1, 1912.

Magnetic and Electric Effects on Light.—P. Zeeman.—A paper giving theoretical consideration concerning light radiation under the simultaneous influence of electric and magnetic forces and suggesting some fundamental experiments. Ever since the discovery in 1896 of the effect of magnetic forces on the frequency of radiation many physicists have inquired whether electric forces do not have also an effect on light emission. So far no such effect has been found. The author suggests a method in which the action of an electric field would manifest itself by a non-symmetric change of a magnetic triplet or by a measurable change of a magnetic doublet.—*Phys. Zeit.*, March 1, 1912.

Electrochemistry and Batteries.

Charging Storage Batteries.—"Variators" (that is, iron resistor wires in a hydrogen atmosphere such as are used as ballast in the Nernst lamp) can be utilized to maintain the current constant as long as the voltage changes at their terminals are within certain limits. This property may be used for charging storage batteries from a constant-voltage supply network. The charge may be done entirely automatically and one does not need to fear that changes in the current and especially an excess of the permitted maximum current may occur. In spite of the increasing counter emf of the storage battery the current is not reduced during the main part of the charging operation—that is, up to 2.5 volts per cell—if only the dimensions of the variators are correctly chosen. This method is especially useful if parallel groups of batteries are to be charged.—*Elek. Zeit.*, Feb. 29, 1912.

Electrical Furnaces and Cost of Energy.—C. Myers.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers on the use of the electric furnace for steel refining, with special reference to English practice. In the discussion which followed F. Foster referred to a recent careful investigation as to the cost of energy for electric furnace purposes in Great Britain. The figures obtained showed that it was possible to generate electric energy at a total cost of 0.30 cent per kw-hr. when using gas producers and ammonia recovery with coal at $2.12 per ton. With blast-furnace gas, coke-oven gas or other waste gases the total cost of generation fell to about 0.2 cent per kw-hour. These costs include capital outlay charges on the whole plant on a liberal scale, and all labor, repairs, stores, water, fuel, etc. In connection with the electric steel furnaces a certain amount of transmission and transformation apparatus would be required, and in general the plant would not be running continuously at full load twenty-four hours a day. These facts would, of course, increase the total cost of electric energy, but, after making due allowance for these factors, it ought to be possible, with furnaces of large size, to deliver electric energy at the furnaces at a cost of 0.5 cent per kw-hr. when using producer gas and 0.4 cent per kw-hr. when using waste gases.—London *Electrician*, March, 1912.

Units, Measurements and Instruments.

Stroboscopic Method of Measuring High Speeds.—J. Schillo.—The author suggests a method of measuring high speeds, for instance, speeds of turbines running from 30,000 to 40,000 r.p.m., by means of a stroboscopic method with the aid of a marked disk placed on the turbine axle and a slotted disk placed on the axle of an auxiliary motor running at an adjustable lower speed. The author gives formulas for calculating the absolute speed of the turbine when the two disks are run in opposite directions.—*Elek. Zeit.*, Feb. 15, 1912.

Telegraphy, Telephony and Signals.

Variation in Intensity of Wireless Telegraph Waves with Distance.—G. W. O. Howe.—The author points out that the common view that in wireless telegraphy the energy varies substantially inversely as the distance, and not inversely as the square of the distance, is a mistake. Experiments of Duddell and Taylor and those of Austin have shown that the received current is inversely proportional to the distance. This received current is set up in the receiving aerial with a given resistance inserted at the base. The received energy, therefore, varies inversely as the square of the distance.—London *Electrician*, March 1, 1912.

Miscellaneous.

Reinforced Concrete.—P. Lecler.—An illustrated article on the uses of reinforced concrete in electrical engineering, especially in the construction of switchboards, conduits and transmission-line poles.—*L'Industrie Elec.*, Feb. 25, 1912.

High-Speed Tool Steels.—L. M. Cohn.—A paper in which the author first gives some commercial notes on the purchase of high-speed tool steels and then refers briefly to the methods of machining them and methods of heat treatment. For hardening, a furnace with a fused bath electrically heated is suitable.—*Elek. Zeit.*, Feb. 29, 1912.

Manufacturing Plant.—E. Dieudonné.—An illustrated description of the equipment and organization of the works of Schneider & Company at Champagne-sur-Seine.—*La Lumière Elec.*, Feb. 24, 1912.

Consolidation of London Electrical Journals.—The proprietors of the (London) *Electrical Engineering* have purchased the copyright and good-will of the (London) *Electrical Engineer* (established 1884), and the latter paper is now incorporated in *Electrical Engineering*.—London *Elec. Eng'ing*, Feb. 15, 1912.

Book Reviews

Testing of Electrical Machinery. For Non-electrical Students. By J. H. Morecroft and F. W. Hehre. New York. D. Van Nostrand. 154 pages, 46 illus. Price, $1.50.

While specifically a college textbook, this volume will be found useful by non-college students of electricity owing to the simple method of exposition, the book being written for the instruction at Columbia University of students in courses of mining, mechanical and civil engineering, etc. The contents are divided about equally between direct-current and alternating-current testing. Prefacing the specific directions for a test is a brief analysis of the characteristics of the machine in terms that can be understood by a student not well versed in electrical theory. To the non-college student the book will serve as an excellent introduction to a regular treatise on testing electrical machinery.

Les Lampes Électriques. Par J. Escard. Paris: H. Dunod et E. Pinat. 426 pages, 307 illus. Price, 15 francs.

While a general treatise on all forms of electric lamps, including gas tubes, the chief interest of this book lies in its descriptions of the newer forms of arc lamps, in the information relating to metallic filaments, and in a lengthy section on the mercury-vapor lamp. The first chapter treats of standards of light, photometric units, photometry and determination of efficiency. The heads of the other chapters are as follows: Arc lamps, electrodes; properties of arcs with respect to the nature of their electrodes; general types of commercial arc lamps; carbon-filament lamps; metallic-filament lamps; mercury-vapor lamps; rarefied gas lamps. The book will interest those who wish a general view of the present status of the electric sources of light.

New Apparatus and Appliances

ELECTRICALLY HEATED METAL POTS FOR LINOTYPE MACHINES.

While electric heating units in many cases cannot be satisfactorily applied to the gas-heated metal pots of linotype, monotype and other type-casting machines, a special electrically heated metal pot has been developed by the General Electric Company to replace the former externally heated pots. The heating element takes 3 kw when turned on full and will heat 65 lb. of type metal to 550 deg. Fahr. in one hour. After the pot is brought up to the proper temperature the energy input can be reduced by control switches on the regulating panel. Type-metal pots offer a desirable long-hour central-station load, and from the standpoint of the user, conduce to composing-room comfort and safety from fire and gas explosions.

PROTECTED STORAGE-BATTERY CONNECTOR.

The United States Light & Heating Company has recently brought out an improved form of bolt connector for connecting adjacent cells of a battery. Fig. 1 shows

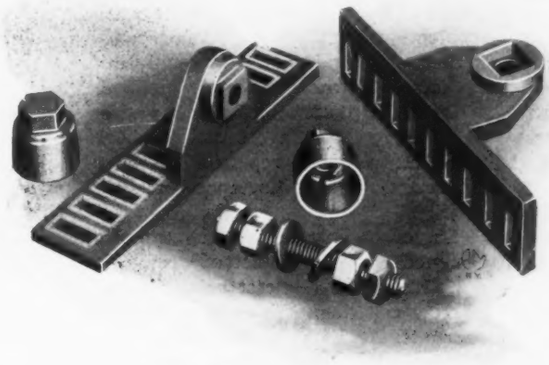


Fig. 1—Parts of Connector.

the parts of the connector, including the lead straps. The rectangular holes in the straps are provided to receive the ends of the plate lugs which are to be burned to the straps. It will be noted that where the strap heads bear against each other there is a square reciprocal joint to prevent the weaving of one strap with reference to the other. The

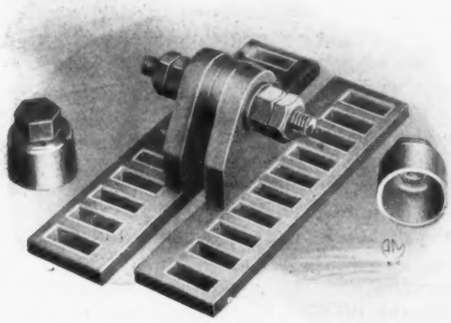


Fig. 2—Parts of Connector Assembled.

stud, two washers, two nuts and two lock-nuts are all of brass. Fig. 2 shows how the connection is securely made by means of the stud and nuts. It will be noted that the parts assembled in Fig. 2 suffice to make the joint mechanically, and that the caps, which are of antimonious lead, are not used for this purpose. Cast into the hexagonal heads of the caps are brass nuts. These caps are intended to be

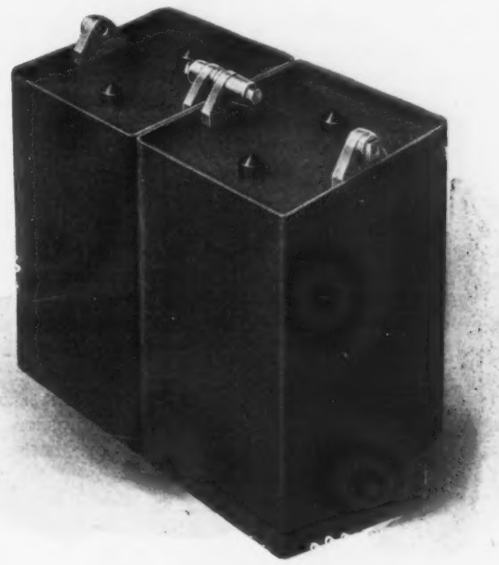
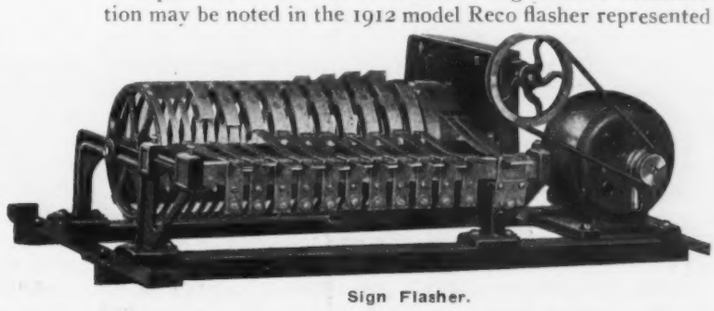


Fig. 3—Two Cells Connected.

loaded with vaseline and screwed onto the ends of the studs, the bowls of the caps to surround entirely all the nuts and washers and to press tightly against the strap heads. A 1-16-in. hole in the crown of each cap provides for the escape of surplus vaseline. An absolutely firm joint is secured by means of this connector, yet no strain is thrown upon the antimonious lead caps. The fact that all the brass parts are completely surrounded by vaseline and that nothing but lead surfaces is exposed precludes the possibility of corrosion. Fig. 3 gives a view of a pair of finished cells with a bolt connector in position. The advantages of the bolt connector are that when the caretaker of the battery wishes to open up a cell he does not need to cut any links or to do any lead burning. The operation consists in the use of a monkey-wrench and a great deal of time is saved. These advantages are maximum with reference to batteries for electric wagons and trucks.

IMPROVED SIGN FLASHER.

Departure from former methods of sign-flasher construction may be noted in the 1912 model Reco flasher represented



Sign Flasher.

in the accompanying illustration. As shown, the segments or contacts are made of heavy brass and fastened by bolts in slots, which extend throughout the circumference of the

drum. By this construction it is possible for any one to rearrange the flashing performance without the aid of any tools, aside from a screwdriver. A flasher of this type, therefore, may be used for a variety of effects other than those for which it is built; furthermore, the same flasher can be used for various signs or displays. Very frequently the sign builder or erector finds a minor adjustment necessary in the flasher, and with the one illustrated a slight change, or, if need be, a radical one, can be effected in a few moments.

Another advantage is the facility with which repairs are made. Should any contact wear or burn out, it can be replaced in a few moments, it being unnecessary to disturb any part of the flasher other than the particular contact or contacts which require renewal. The collector ring is fastened in a slot by two screws in the same manner as the contacts. The brush holders clamp the brushes to a slate bar and enable the quick adjustment of a brush. The holder also acts as a terminal for wiring connections and has upturned lugs as required by the National Board of Fire Underwriters. The worm and gear are inclosed in an oil-tight case and constitute a noiseless and self-lubricating transmission. The worm shaft runs on roller bearings. The bed-plate of the machine is made of wrought angle iron and has an extension platform for the motor. The motor is fitted with a double-groove pulley of different sizes for speed adjustment. The Reynolds Electric Flasher Manufacturing Company, of Chicago and New York, is the maker of this machine.

ELECTRIC SOLDER POTS.

Electric solder pots for individual use form the most satisfactory, economical and safe means of melting and keeping in a liquid state such metals as solder, tin, lead and babbitt. They reduce the fire hazard, keep the loss of metal through oxidization to a minimum, and introduce no unhygienic conditions, such as fumes and smoke, into the workroom. The uniformity of the temperature of the melted metal is also a valuable feature; if the pot is kept filled, the temperature of the metal will always be at the proper point.

Electric Solder Pot.

The pots built by the Westinghouse Electric & Manufacturing Company are substantially constructed in order to withstand the abuse to which they are subjected in service, and are made of drawn steel. The heating element is of the immersion type; it is separate from the pot and in direct contact with the metal to be melted. This insures quick melting and high efficiency. None of the heat is wasted, as it must pass through the molten metal before any can escape. The heating element is hermetically sealed under pressure in an iron jacket and is practically indestructible. The heater can be run at two temperatures, the high heat for melting the metal quickly and the low heat for keeping it in a liquid state. A push-button switch controls the temperature and indicates which heat is being used. An iron ladle is regularly supplied with each pot.

SERIES TRANSFORMERS.

The use of series or so-called "current" transformers for the purpose of insulating meters, trip coils, etc., from the main line voltage has been common since the earliest days of electrical engineering. Up to the last few years the design of such transformers has presented no different problem, as far as insulation is concerned, from that found on constant-potential transformers, but with the advent of the centralized generating plant with its enormous amounts of power and the use of the steam or water turbine with its enormous stored energy which is available on a short circuit, the design of any apparatus which may be subjected to the strains of these short-circuits has become a serious problem. This is particularly true with series transformers, as they are placed in series with the generator and therefore are subjected to all of the strains due to the passage of excessive currents.

These transformers are used to protect circuit-breaker coils and instruments, and the failure of their insulation from any cause would result not only in a short-circuit but in a charging of normally dead apparatus to such an extent that accidental contact would cause the loss of human life. It is therefore evident that the insulation of such transformers is an extremely important feature. Mechanical strength is also of great importance, as cases have been known where transformers have been literally blown apart owing to the electromagnetic repulsion of the windings on heavy short-circuits, and such instances are far from being rare.

There is being offered a type of series transformer which has been designed with the object of providing ample insulation to withstand the severest conditions. The transformer is narrow and therefore occupies the least possible space and permits the wires to be placed close together. The iron magnetic circuit is in the shape of a rectangle on a long leg of which are wound both the primary and the secondary winding.

The magnetic circuit is first covered by the insulation, over which are placed the secondary winding and then more insulation, and then the primary winding; finally, the whole device is wound with insulation, and thus every particle of insulation and winding adds to the ability of the transformer to withstand disruptive strains. Owing to the employment of this particular type of magnetic circuit and winding, it is also possible to use a solid conductor for the primary winding instead of a multitude of small wires. All primary coils are tested at a potential three times the normal potential of the circuit on which they are to be operated, and all transformers up to and including those designed to withstand high-potential tests of 90,000 volts are dry-insulated and will withstand this test without the use of any oil or containing case. The construction is such as to allow the use of insulation in solid sheets, thus resulting in a structure in which the insulation is not only of a high dielectric strength but is also extremely rugged mechanically.

The transformers are impregnated by the vacuum and pressure process, but this impregnation is not depended on to add to the insulating strength of the transformers. Its main use is to prevent the absorption of moisture and to bind the parts together mechanically and prevent the continued heating and cooling of the transformer from causing the insulation to scrape or crack.

The above-described type of transformer has been placed on the market by the Condit Electrical Manufacturing Company, Boston, Mass.

ELECTRICAL EXHIBITS AT THE BOSTON COMMERCIAL VEHICLE SHOW.

The Boston Commercial Motor-Vehicle Show opened on March 13 and closed on March 20 in the Mechanics' Building, Huntington Avenue, following the regular automobile show by a three-day interval. As the latter exhibition established a new record in the number of pleasure cars displayed, the former put a new high mark upon the number of cars and chassis of commercial type shown in America. A total of 242 trucks, wagons and chassis were shown, sixty-four different makers being represented. The attendance record indicated that a larger proportion of persons receiving tickets attended the Boston show than were registered at either the New York or Chicago commercial displays. The attendance on the opening night compared favorably with that on the evening when the pleasure car show was thrown open to the public, and great interest in the economies of motor transportation was manifested until the close of the exhibition.

The Couple-Gear Freight-Wheel Company, Grand Rapids, Mich., represented by Mr. W. E. Eldredge, Boston, exhibited a 5-ton electric coal wagon equipped with U. S. "National" batteries, a 5-ton caravan, a 2-ton truck and a gasoline-electric truck. Interest centered in the large coal truck, five of which have been ordered since the show opened by the Metropolitan Coal Company, of Boston, making a total of seven which will shortly be in service. This equipment is provided with steel-tired rear wheels, which carry 90 per cent of the paying load, and the makers contend that some of the most striking economies of the electric truck have resulted from the use of the front wheel drive.

The Waverley Company, Indianapolis, Ind., through the J. W. Bowman Company, Boston, showed a 600-lb. wagon, a chassis for a 2000-lb. car and a 1200-lb. wagon with inclosed panel-type body. The 600-lb. wagon was provided with full elliptic springs, all running parts moving in oil, anti-friction bearings and "Philadelphia" battery. This machine was practically the smallest truck shown in the building and was pointed out as one of twenty recently ordered for service in the fleet of the Fleischmann Yeast Company, of New York. Its speed was given as 15 miles per hour, and its run per charge as 50 miles. The chassis for the 2000-lb. truck was built of armored wood and was equipped with Renold silent chain drive with countershaft transmission. Timken roller bearings and the bushing of all wearing parts with grease cups were other features emphasized.

The Lansden Company, Newark, N. J., represented by W. J. Dow, showed a 5-ton truck and a 2-ton outfit, with side-loading batteries, frames of pressed steel, Timken bearings, in wheels and countershaft, Hess-Bright motor bearings, Edison battery, silent chain main drive and Hindley steering head. A 1000-lb. delivery wagon capable of running 60 miles per charge and making a maximum speed of 14 miles per hour was also shown, this equipment being of the panel-body type.

The Walker Vehicle Company, Chicago, which was represented by J. W. Emery, Boston, displayed a 3000-lb. truck of the Walker balanced-drive type, which made the trip from New York to Boston prior to the show in twenty-one hours. This achievment was advertised at the company's booth as the battery which delivered itself. A light delivery wagon of 750-lb. capacity for bakery service was also exhibited, the machine having made a record of continuous daily service in the northern suburbs of Boston throughout the entire winter season. Two brakes are now being installed on all the company's equipment, one being for regular and the other for emergency operation.

The General Vehicle Company, Long Island City, N. Y., represented by Day Baker, Boston, occupied an attractive space in the center of the exhibit hall and displayed a 5-ton brewery truck, two 2-ton Pureoxia wagons, a light delivery wagon for show service, a 1-ton chassis and an electric ambulance equipped with an Edison battery and capable of making a speed of 22 miles per hour. The company emphasized the extreme simplicity of its chassis, the use of a series motor, covered Morse driving chains with plain rollers and no worm or bevel gears. Special attention was also called to the arrangement of the motor suspension, which consists of a bar carrying the motor frame, the former being attached to the channel irons of the machine frame by bolted pockets. The company has arranged to deliver an electric ambulance to the Newton Hospital. It sold more trucks through its location than at any previous show.

The General Motors Truck Company, of Detroit, represented by Mr. R. M. Ketchum, Boston, showed a 3-ton chassis, a 1½-ton truck for express service and a 6-ton electric brewery truck, the last machine being built for a speed of 6.5 miles per hour and the 1½-ton unit for 10 miles per hour. Among the special features emphasized were the use of new standards of construction, varied styles of bodies and platforms, steel frame, positive motor alignment, ball bearings, absence of automatic control features and adaptability to different batteries.

The Baker Motor Vehicle Company, Cleveland, represented by Mr. F. N. Phelps, Boston, exhibited an ambulance of attractive design, a delivery wagon and an express truck. The principal features emphasized were the suspension of the power plant above the springs, the use of roller axle bearings, double brake mechanism, four-pole series motor, inclosed motor and countershaft, Renold silent chain running in oil, continuous torque drum-type controller, and acid and weatherproof wiring. The ambulance attracted much attention on account of the beauty of its finish, there being accommodations for two patients and two attendants, with interior electric lighting and cheerful furnishings.

The Philadelphia Storage Battery Company showed an assortment of plates and connections and an ingenious scale balance made of battery parts and fittings. A feature was the display of battery discharge and voltage curves in the form of blueprints fastened against horizontal glass windows in a special casing illuminated from below by sixteen incandescent lamps of the frosted-bulb type, the latter being rated at 8 cp each. D. C. Tiffany & Company, Boston, represented the company.

The Westinghouse Electric & Manufacturing Company, Boston office, had an extensive display of vehicle motor and control equipment, battery-charging motor-generator set and switchboard panels, and utility motors for polishing and grinding. Two vehicle motors of 2½-hp and 4-hp rating were shown, and special attention was called to the controlling and rheostatic apparatus. All the vital parts of an electric vehicle's electrical equipment were exhibited in a compact space. A feature was the display of a shunt-wound, interpole-charging generator direct-driven by a 7½-hp induction motor mounted on a common bedplate, the voltage range being from 60 to 120 on the generator side. Messrs. Patterson and Mansfield were in charge of the exhibit.

Other exhibitors of electrical and related equipment were the International Acheson Graphite Company, Dodge Motor Vehicle Company, American Storage Battery Company, Electric Storage Battery Company, Edison Storage Battery Company, Ford Motor Company, Gray & Davis, National Carbon Company, New England Telephone & Telegraph Company, Pyrene Manufacturing Company of New England, Remy Electrical Company, C. F. Splitdorf, Inc., United States Light & Heating Company.

Industrial and Commercial News

PROSPECTS of early settlement of the British coal strike by means of the miners' minimum wage bill and the possibility of federal intervention in the proposed strikes in the bituminous and anthracite fields of this country have had a beneficial effect upon trade conditions this week, so that progress continues to be made steadily along industrial lines. This is borne out by increases in freight tonnages handled by the railroads in the past few weeks, the improvement being most noticeable upon roads in the Middle West. The annual report of the United States Steel Corporation, issued this week showed that 1911 was a year of restriction. The income account showed a decrease of $36,649,288, the results being the poorest since 1908. Exports increased 41.4 per cent over those in the previous year, and total shipments showed a falling off of 18.6 per cent. An incident of encouragement during the week was the government report on the country's foreign trade in February, which stated that exports from this country were $198,873,423 in that month, the largest February total ever reached. Rates in the money market March 20 were: Call, 2⅛@2½ per cent; ninety days, 3¼@3½ per cent.

THE COPPER MARKET.

As a result of industrial conditions in Great Britain, there has been very little disposition on the part of foreign buyers to enter the copper market to any extent this week, although a fair volume of inquiries is reported from continental Europe. In this country inquiries have been rather active, and domestic consumers have purchased several million pounds of electrolytic, since last report, for April shipment, in order to fortify themselves in the event of any disturbances that may result from serious labor troubles. Prices have advanced sharply, and the majority of agencies are asking 14¾ cents per pound, some asking 15 cents. Electrolytic is quoted abroad nominally at £67 15s. to £68. The fortnightly statistics for Great Britain and France, issued March 18, showed a decrease of 50 tons in stocks and 529 tons in copper afloat, a total decrease of 580 tons, and the total visible supply on March 15 stood at 51,095 tons. Exports from this country during the month, including March 20, aggregate 14,530 tons. The daily call on the Metal Exchange March 20 quoted copper as per the accompanying table.

Standard.	Bid.	Asked.	Settling Price.
Spot	14.37½	14.62½	....
March	14.37½	14.62½	14.50
April	14.37½	14.62½	14.50
May	14.37½	14.62½	14.50
June	14.37½	14.62½	14.50
July	14.37½	14.62½	14.50

The London market, March 20, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	66 0 0	65 17 6
Standard copper, futures	66 15 0	66 11 3

Price extremes in 1912:

	Highest.	Lowest.
Standard	14.50c	13.65c
London, spot	£66 1 3	£60 16 3
London, futures	66 16 3	61 10 0
Best selected	70 0 0	65 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

United Light & Railways Merger.—As noted briefly last week, the United Light & Railways Company, of Grand Rapids, Mich., has arranged to secure the control of the Tri-City Railway & Light Company, operating all the gas, electric-service and street-railway properties in Davenport, Ia., and Rock Island, Moline and East Moline, Ill. The interurban railway from Davenport to Muscatine, Ia., will be also acquired by the United company. It is announced in addition that that company will acquire the Ottumwa (Ia.) Gas Light, Heat & Power Company, and that it has options also on several other properties. The United company now owns gas companies in Chattanooga, Tenn.; Cedar Rapids, Ia.; Cadillac, Mich.; Laporte, Ind., and Mattoon, Ill. It also has an electric-service property in Laporte, Ind., and the combined gas and electric company in Fort Dodge, Ia., as well as the gas, electric and street-railway company of Muscatine, Ia., and the Grand Rapids, Grand Haven & Muskegon Railway Company. Besides these, it owns district-heating plants in Davenport, Ia., and Laporte, Ind., and the Pintsch gas plant in Chattanooga, Tenn. It is contemplated that all of the properties owned in Iowa shall be operated from a district office at Davenport under the supervision of J. F. Porter, now president of the Tri-City Railway & Light Company. In time the financial headquarters of the United company will probably be removed to Chicago, as the recent enlargement requires the issuing of new securities, in which a large amount of Chicago capital will be invested. The president of the company is Frank T. Hulswit, and the present board of directors consists largely of Grand Rapids business men. In addition, it is planned to place on the board Samuel Insull, of Chicago; J. G. White, of New York; Edward P. Russell (of Russell, Brewster & Company), of Chicago; George B. Caldwell (vice-president of the Continental and Commercial Trust and Savings Bank), of Chicago; William Butterworth (president of Deere & Company), of Moline; J. F. Porter, of Davenport, and E. G. Filer, of Filer City, Mich. Mr. Porter will become a vice-president, and it is planned that Messrs. Russell, Insull, White and Porter shall be added to the executive committee. Under the new arrangement the total capitalization of the United Light & Railways Company will be $17,612,500, divided into $4,375,000 in 5 per cent bonds, $5,000,000 in first preferred stock, $3,000,000 in second preferred stock and $5,237,500 in common stock. It is estimated that the gross earnings of the combined properties for the year 1912 will be $4,400,000 and the net earnings $1,840,000. All of the additional issue of securities of the United Light & Railways Company has been underwritten by Chicago and New York banking houses.

Foreign Trade Opportunities.—Under Schedule No. 8378 on file with the Bureau of Manufactures, Washington, D. C., an American consul in the United Kingdom reports that a firm of contractors and agents in his district desires to be put in touch with American manufacturers of stationary and movable electric vacuum cleaners, electric heating and cooking apparatus of all kinds, electric stage-effect apparatus for theatres, music halls, etc., electric and automatic window-advertising devices, etc. Under Schedule No. 8398 an American consular officer in a European country reports that a firm in his district informs him that it is in the market for 10,000 electric switches similar to one which was seen on an American meat-cutting machine, with "Hubbell, 10 amp, 250 volts," pressed into the vulcan fiber cover. The firm in question is very anxious to find out who manufactures these switches. Further details on the above can be obtained upon application to the Bureau of Manufactures, Washington, D. C.

National Commercial Association.—A meeting will be held April 22 in Washington under the auspices of the Secretary of Commerce and Labor to organize a national commercial association. The chambers of commerce of leading cities will have representatives present, and among the manufacturers' organizations that will be represented are the American Manufacturers' Export Association, National Association of Manufacturers, American Paper & Pulp Association, National Association of Cotton Manufacturers, National Paint, Oil & Varnish Association and American Association of Woolen & Worsted Manufacturers. Other organizations desiring to join the movement are requested by the Department of Commerce and Labor to send in the names of their representatives at the earliest possible date.

Winnipeg Utilities Rumor.—The Mackenzie and Mann interests in Winnipeg, Man., including the street railway lines and light, heat and power systems, have been sold to the Manitoba Power Company, composed of R. R. and A. G. Muir, E. B. Reese and D. L. Mathers, according to a Winnipeg dispatch. It was said that J. P. Morgan & Company had purchased these properties, but a representative of the banking house has denied that the firm is in any way connected with the deal.

Commonwealth Edison Orders 40,000-hp Parsons Turbine Unit Abroad.—The Commonwealth Edison Company, Chicago, has placed an order with Charles A. Parsons & Company, Newcastle-on-Tyne, England, for a 25,000-kw turbo-generator set for installation in its Fisk Street station. This machine is to be built from designs made by Sir Charles A. Parsons himself, who will also supervise its manufacture at the Newcastle works. The maximum rating of the turbine will be approximately 40,000 hp. It is understood, unofficially, that the turbine will be a two-chamber horizontal machine, the low-pressure end being of the double-flow type. The arrangement of the condenser will be entirely new and the turbine will be of a Parsons type not made in this country. The generating unit will be 75 ft. long and 18 ft. wide, and it is expected that the Fisk Street station will ultimately house four of the units. The station enlarged will then have a rating of 220,000 kw. The generator will be wound for 4500 volts, three-phase, 25 cycles, and will have a speed of 750 r.p.m. The exciter will be mounted on one end of the shaft and the auxiliaries will be placed in the basement. It is stated that the unit will require no greater floor space than a vertical unit of equal rating, and by an ingenious rearrangement of boilers and economizers no greater ground area will be needed for the additional steam-raising equipment, although extensions will be necessary to the coal-handling equipment. All the auxiliaries will be electrically driven and of the rotary type. The unit will be shipped to the United States from England before the end of the year.

Federal Sign System (Electric) Notes.—Further details in connection with the purchase of the sign business and patents of the Metropolitan Engineering Company, of New York, by the Federal Sign System (Electric), of Chicago, referred to in these columns Feb. 3, have been ascertained. The factory equipment of the Metropolitan company for the production of electric signs has been moved to the new Federal factory in New York on Fifty-sixth Street, near Tenth Avenue. R. M. Mann, formerly with the Metropolitan company, has gone with the Federal company and handles the rental end of the latter company's business in New York City. W. W. Tower is the New York manager for the Federal company, and C. B. Graves is in charge of sales. The Metropolitan company, as previously stated, will continue with the manufacture of the Murray porcelain specialties.

United Wireless Reorganization.—A plan for reorganizing the United Wireless Company has been agreed upon, and according to Arthur P. West, chairman of the reorganization committee, holders of over 300,000 shares of stock have assented, and an equal number have agreed to come into the reorganization provided the time limit is extended to April 15. This has been granted. As regards negotiations toward consolidation of the United company with the Marconi Wireless Company, it is understood that offers of the United company for a merging of interests were made too late, and that the Marconi interests will continue their suit against the United concern for infringement of patent rights.

American Light & Traction Meeting.—At the annual meeting of the American Light & Traction Company, 40 Wall Street, New York City, on March 18, F. Q. Brown, of Redmond & Company, New York, and C. N. Jelliffe, secretary of the American Light & Traction Company, were elected directors, to succeed W. L. Bull and J. M. McCarthy, both of whom retired on account of ill-health. Other directors were re-elected. A meeting of the board for organization and election of officers will take place April 2.

Jamestown (N. Y.) Light & Power Company Buys Lakewood Property.—The Jamestown (N. Y.) Light & Power Company has purchased under mortgage foreclosure proceedings the property of the Lakewood Electric Light & Power Company, of Lakewood, N. Y. Since Dec. 1 the village of Lakewood has been supplied with electricity for lighting by the Western New York Light & Power Company, some of the stockholders of which are also owners of stock of the Jamestown Light & Power Company.

Mount Shasta Power Corporation Incorporated in California.—Articles of incorporation have been filed by the Mount Shasta Power Corporation, which plans to enter the light and power field in California and possibly operate in San Francisco at a future time. The company is capitalized at $10,000,000, and the incorporators are representatives of McKinstry & Raymond, San Francisco, attorneys for the promoters of the project, whose names have not been made public.

14,000-hp Water Turbine for Niagara.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has entered into a contract to furnish to the Ontario Power Company, of Niagara Falls, a 14,000-hp hydraulic turbine unit for its power plant at Niagara Falls, consisting of two Francis-type central discharge wheels. Heretofore the Ontario company has purchased only European-built turbines.

Catalogues Wanted.—The United States Reclamation Service desires to receive for file in its office at Hermiston, Ore., which has charge of the Umatilla project, catalogues relating to supplies, tools, instruments, equipment, labor-saving devices and improved machinery of all sorts generally used in constructing the irrigation works the United States Reclamation Service has in hand.

Isthmian Canal Contract.—The General Electric Company was the lowest bidder for constructing the electric system to control the locks on the Panama Canal. The amount of the contract is about $200,000.

Aluminum Notes and Prices.—The aluminum market continues steady. Prices March 20 were 19 @ 20 cents for ingots for remelting, in large lots, 31 cents for rods and wire, and 33 cents for sheets.

Financial

Allis-Chalmers Reorganization Plan.—The committees acting for the bondholders and stockholders of the Allis-Chalmers Company have completed plans which they hope will restore the company to a satisfactory financial condition. As previously noted in these columns, the present capitalization of the company is $47,018,000, as follows: First mortgage 5 per cent bonds, $11,148,000; 7 per cent cumulative preferred stock, $16,050,000, and common stock, $19,820,000. Under the plan for reorganization a new corporation is to be organized with an authorized capital stock of $42,500,000, divided as follows: Seven per cent cumulative preferred stock, $16,500,000; common stock, $26,000,000. The preferred stock is to be entitled to preference not only as to dividends but also as to principal in case of liquidation, and if found practicable it is to have power to elect a majority of the board of directors and to be redeemable at 110. A voting trust of the new preferred and common stock is to be created for five years, with five voting trustees, who are to be appointed by the reorganization committee. To provide funds for purposes of reorganization and to supply the new company with additional working capital, there will be an assessment of 20 per cent on the old preferred stock, amounting to $3,210,000, and there will be an assessment of 10 per cent on the common stock, or $1,982,000, making a total of $5,192,000. Ten per cent of the respective assessments will be payable on deposit of share certificates and the balance on or after Oct. 1, 1912, on thirty days' notice by the reorganization committee. The new preferred stock will be distributed as follows: To holders of 5 per cent bonds, $11,148,000; to stockholders or underwriters on payment of assessments, $5,192,000; surplus, $160,000. The new common stock will be distributed as follows: To holders of 5 per cent bonds, 35 per cent of holdings in consideration of release of lien and fixed charges, $3,901,800; to holders of preferred stock, 90 per cent, $14,445,000; to holders of common stock, 35 per cent, $6,937,000; surplus, $716,200. Bondholders and stockholders depositing under the reorganization agreement will receive on completion of reorganization shares of new preferred and common stock, or voting trust certificates, as follows: (a) For each $1,000 5 per cent bond, (1) new preferred stock, $1,000; (2) new common stock, $350; (3) Jan. 1, 1912, coupon in cash, $25; total, $1,375. (b) For each $100 par share of preferred stock, upon payment of 20 per cent assessment, $20 in cash, (1) new preferred stock, $20; (2) new common stock, $90, making $110 par value. (c) For

each $100 par value of common stock, upon payment in cash of 10 per cent assessment, $10 in cash, (1) new preferred stock, $10, and (2) new common stock, $35, making $45, par value. A friendly receiver, probably President Call, will be appointed. There is a likelihood, according to one of the members of the committee, that in order to concentrate the affairs of the company the present offices will be removed from New York. The plan was drawn up by the bondholders' committee and agreed to by the preferred and common stockholders' protective committees.

Bell Telephone Report.—The report of the American Telephone & Telegraph Company for the year ended Dec. 31, 1911, has been issued, and shows results for the Bell Telephone System in the United States during that year as follows: Gross earnings, $179,477,998, an increase of $13,865,117; expenses, $127,891,701, an increase of $13,273,228, and net earnings, $51,586,297, an increase of $591,889; interest, $13,610,860; net profits for the year, $37,975,437, a decrease of $1,462,107; dividends $25,966,876, and surplus earnings, $12,008,561, a decrease of $2,268,197 as compared with the results in 1910. Total earnings of the American Telephone & Telegraph Company for the year ended Dec. 31, 1911, were $36,970,229, as compared with $35,358,328 in 1910, and were made up as follows: Dividends, $20,844,398; interest and other revenue from associated companies, $10,462,787; telephone traffic (net), $4,979,232; real estate, $92,854, and other sources, $590,958. Expenses were $3,668,984, and net earnings $33,301,245, an increase of $1,368,031. Deducting interest, $5,567,980, and dividends paid, $22,169,449, a balance remained of $5,563,816, of which $2,800,000 was carried to reserves and $2,763,816 to surplus. At the end of the year the Bell system had 6,632,625 stations in the United States, an increase of 749,906 over the number in use the previous year, and its lines now reach 70,000 places, from many of which a telegraph message can be sent. It is estimated that about $56,000,000 will be required for current additions to plants in 1912, of which $30,000,000 will be provided from existing resources of the company. The question of accumulation of reserves is discussed in detail in the report, and the conclusions of the management are summed up as follows: "The only sound conclusion that can be reached after full consideration of all the various phases and factors of the problem is that ample reserves should be provided to meet not only probable happenings but possible happenings, and that such reserves should be so invested that whatever increment or revenue is to be derived from the amounts unexpended or not used for the purposes intended will go to the public in reduction of charges for or in improvement of service, and that the value of a public-utility plant should be represented by a relatively small percentage of outstanding securities calling for fixed charges. No expenditure which does not produce increased net revenue should be capitalized." On the question of government ownership Mr. Vail says in part: "We believe and we think that the public is fast coming to believe that telephone service to be perfect must be universal, intercommunicating, interdependent, under one control, and that no isolated section can be considered independently of any other or of the whole system, and that rates must be so adjusted as to make it possible for every one to be connected who will add to the value of the system to others. * * * The discussion of the government ownership of the wire companies is not likely to become anything more than academic, at least for the present. Even if the final conclusion should favor government purchase of all wire plants, there would be no unfavorable consequences to the shareholders of the wire companies other than the obligatory liquidation. Any possible award for the property which the security holders would be obliged to accept would give them better than current prices for their securities."

Receivers for McCrum-Howell Company.—Upon application of George H. Burr & Company, fiscal agents for the McCrum-Howell Company, said to be the largest manufacturer of vacuum-cleaning systems in the world and a large manufacturer of radiators, boilers and enameled ware, federal judges have appointed receivers for the concern in New York, Philadelphia, Chicago and several other cities. This follows a spectacular break in the shares of the company on the Chicago Stock Exchange last week and is attributed in a large degree to the effects upon the credit of the company resulting from the government suit against the so-called "bath-tub trust," of which it was alleged the company was a member. The affairs of the concern date from 1904, when the Kelly-Richmond Company was incorporated in Connecticut with a capital stock of $500,000. This was later increased to $1,500,000 and the name changed to the Kellogg-McCrum-Howell Company. The name was changed to the McCrum-Howell Company in 1906, and in 1909 the capital stock was increased to $3,000,000, and to $7,000,000 in 1910. The company has plants, buildings, etc., in Uniontown, Pa.; Norwich, Conn.; Tacony, Pa., Chicago, Ill.; Racine, Wis., and at several other places. Lloyd G. McCrum is its president and treasurer, George D. Howell and W. A. Cameron are vice-presidents, Howard T. Gates is secretary, and L. P. Gates assistant treasurer. The general offices are at 103 Park Avenue, New York City. The last annual report of the company on April 1, 1911, showed assets of $8,387,496, and liabilities, accounts and bills payable of $562,803, capital stock of $7,000,000 and a surplus of $612,615. An inventory and investigation of its condition are now in progress, and a report is expected shortly which will furnish a basis for future action.

New York Edison's 1911 Statement.—The Public Service Commission for the First District of New York has issued a summary of the income and surplus accounts of the New York Edison Company for 1911. This shows operating revenue of $19,689,851, and total revenue deductions of $8,287,462, as follows: Operating expenses, $6,950,082; taxes, $1,270,051; uncollectible bills, $67,328, leaving operating income of $11,402,388. Interest revenues were $977,924; dividend revenues were $100,890; miscellaneous rents were $26,026, and steam sold to the United States Post Office brought $5,931, making a total of $1,110,773. Non-operating revenue deductions, including $11,081 for steam purchased from the Pennsylvania Railroad Company, were $30,208, leaving non-operating income of $1,080,564, which with operating income as above made gross income applicable to corporate and leased properties of $12,482,952. Total income deductions amounted to $3,801,796, and consisted of interest accrued on funded debt, $1,694,925; other interest deductions, $871,435; rent for lease of other electric plant, $47,656; subway rents, $1,189,690; miscellaneous rents, $3,750, against which accounts is a credit of $5,661 for amortization of premium on debt. These deductions left a net corporate income of $8,681,156. Other credits to the surplus amounted to $17,345, which with the previous surplus of $20,381,839 made a total of $29,080,340. From this was deducted renewal and contingency reserve of $2,688,556, 6 per cent dividends on $50,153,400, of $3,009,204, and miscellaneous debits of $5,091, a total of $5,702,851, leaving a surplus at the close of the year of $23,377,489.

H. L. Doherty Opposes Voting Trust for American Gas & Electric.—The following statement has been issued by Henry L. Doherty in opposition to a plan to extend the voting trust of the American Gas & Electric Company for a number of years: "When the American Gas & Electric Company was organized there was good reason for asking the stockholders to put their stock in a voting trust, as there was much to be done to finance and put the individual properties on a stronger footing. Shortly before the expiration of the present voting trust I was asked to join in an effort to extend this voting trust or to create a new one, but refused to do so, as I did not feel there was any need for such a trust, and I see no reason why a stockholder should assign away his right of control to the corporation which he owns without some very good reason. I requested of the trustees a list of the holders of voting trust certificates so I could advise them against giving away their rights, only to receive a flat refusal, hence I decided to make a public announcement and save further delay." Mr. Doherty was president of the American Gas & Electric Company several years ago. The foregoing announcement is taken by many to mean that Mr. Doherty intends to take steps to secure control of the company.

H. M. Byllesby May Supervise Toledo Railways & Light Company.—It is stated that H. M. Byllesby & Company, of Chicago, have completed an examination of the Toledo Railways & Light Company and are negotiating with the bondholders' and stockholders' committees with a view to

arranging a reorganization plan under which such interest in the company may be acquired by the Byllesby company as will give the Toledo company the benefit of its supervision. The committees will meet March 27.

West Penn Traction & Water Power Company Proposed.—Stockholders of the West Penn Traction Company, of Pittsburgh, will vote at a special meeting April 4 on a proposition of the American Water Works & Guarantee Company to form a new concern to be known as the West Penn Traction & Water Power Company. The capitalization of the new company will consist of $6,500,000 6 per cent cumulative preferred stock and $20,500,000 common stock. The American Water Works & Guarantee Company was chartered in Pennsylvania in 1882, to purchase, build and operate water-works, gas and electric plants throughout the United States, and is said to be the largest operating water-works company in the country. It operates over forty water-works plants in various sections of the country, and has large interests in various public utilities. The West Penn Traction Company was incorporated in 1910 to take over control of the West Penn Railways in the interest of the American Water Works & Guarantee Company. The latter agreed to take up all bond issues made by the West Penn Railways within the next two years, provide for all necessary extensions to the property, etc. Common stockholders of the West Penn Railways, in consideration of the above, were given the right to exchange their shares for those of the West Penn Traction Company, the basis of exchange being 50 per cent in 6 per cent cumulative preferred and 100 per cent in common stock of the West Penn Traction for each share of the West Penn Railways stock.

1911 Financial Statement of Federal Light & Traction Company.—C. C. Chappelle, vice-president and general manager of the Federal Light & Traction Company, 60 Broadway, New York, has issued the financial statement of the company for the fiscal year ended Dec. 31, 1911. During this time the gross earning power of properties controlled by the company, after elimination of inter-company earnings and including properties acquired, increased from $722,552 to $1,496,177 and net earnings increased from $314,156 to $609,082. The capitalization of the company, based on recent financing mentioned in these columns Feb. 24, according to the report, is as follows: (1) Common stock, authorized $5,500,000, outstanding $4,750,000; 6 per cent cumulative preferred stock, authorized $5,500,000, outstanding $2,500,000; (2) first-lien 5 per cent gold bonds, due 1942, authorized $50,000,000, outstanding $3,000,000; ten-year 6 per cent debentures, authorized $1,500,000, all outstanding; 5 per cent secured notes, due 1914, $500,000, all outstanding; (3) 5 per cent first-lien bonds of the Springfield Railway & Light Company, due 1926, authorized $7,000,000, outstanding $2,000,000. The report places the assets of the company as $14,683,634 and calls attention to the acquisition during the year of the railway, gas, electric and steam-heating properties in Springfield, Mo., and of the electric, gas, interurban and local railway properties in Trinidad, Col., previously noted in these columns from time to time.

Otis Elevator Report.—The pamphlet report of the Otis Elevator Company for the year ended Dec. 31, 1911, has been issued, and shows net earnings, after deduction of all charges for interest, patent expenses, renewals and repairs for plant maintenance, of $1,082,116 as compared with $1,157,371 in 1910. Preferred dividends were $385,975 as compared with $381,109, leaving $696,141 available for dividends upon the common stock. This compares with $776,262 in the preceding year, and is equal to 10.91 per cent on $6,375,000 common stock before clearing out current depreciation, as compared with 12.17 per cent on the same amount of stock in 1910. Common stock dividends amounted to $255,012, leaving a balance of $441,129 as against $521,250 in the previous year. Depreciation was $331,019 and $391,124 in 1911 and 1910 respectively. The surplus for 1911 was $110,110, which compares with $130,125 in 1910. The general balance sheet as of Dec. 31, 1911, showed assets of $21,159,506.

Kellogg Switchboard & Supply Company Statement.—The balance sheet of the Kellogg Switchboard & Supply Company, of Chicago, as of Dec. 31, 1911, shows total assets of $2,422,569, made up as follows: Plant, real estate, machinery, tools, etc., $522,044, after deduction of $256,926 in 1911 for depreciation reserves; accounts, notes receivable, $830,318; cash on hand, $54,805; inventories, $1,010,748; unearned insurance premiums, $4,654. Liabilities were as follows: Capital stock issued, $1,000,000; pay roll and taxes accrued, $31,226; trade and miscellaneous accounts, $54,502; reserve for bad and doubtful accounts, $81,555; surplus, $1,255,286, after deduction of $120,000 dividends, comparing with $1,211,727 in 1910, after payment of $607,000 dividends; total, $2,422,569.

Annual Report of the Public Service Corporation of New Jersey.—The annual report of the Public Service Corporation of New Jersey, made public this week, shows the earnings and expenses of the corporation, the Public Service Gas Company, the Public Service Railway Company and the subsidiary companies for the year ended Dec. 31, 1911, as follows: Gross earnings of leased and controlled companies, $30,125,508; operating expenses and taxes, $15,941,691; amortization charges, $672,653, and a balance of $13,511,163. The income of the Public Service Corporation from securities pledged and from miscellaneous sources was $1,890,512. Bond interest and rentals of leased and controlled companies amounted to $11,066,051; the fixed charges were $2,540,242, and the surplus was $1,794,781.

Canadian Telephone Returns.—A report on telephone companies operating in Canada, submitted to the Dominion Parliament by the Minister of Railways, shows a total capital liability of 537 companies amounting to $40,943,982, of which $21,527,374 is represented by stock and $18,516,608 by funded debt. The cost of telephone plant and property in Canada is placed at $34,737,527. The gross earnings reported for the year were $19,968,220, and operating expenses were $6,979,045. Net earnings were $3,089,174. The statement of the Bell Telephone Company of Canada, Ltd., shows a capital of $12,500,000, funded debt of $4,899,999, cost of property and equipment of $21,251,370, revenue of $5,968,932 and operating expenses of $4,023,262. It also shows 426,545 miles of wire in operation, including 1700 miles of submarine cable and 7057 employees.

Republic Railway & Light Company Earnings.—In the twelve months ended Jan. 31, 1912, the consolidated gross earnings of the subsidiaries of the Republic Railway & Light Company, 60 Broadway, New York, were $2,389,203, as compared with $2,258,873 in the corresponding period last year, a gain of 5.77 per cent. Operating expenses and taxes were $1,416,397, an increase of 6.38 per cent, and net earnings were $972,806, a gain of 4.88 per cent. Interest on funded debt was $531,374, as compared with $508,129, an increase of 4.57 per cent, and the surplus for the period was $441,431 as compared with $419,412, an increase of 5.25 per cent.

American Cities Notes.—Assets of the American Cities Company as of Dec. 31, 1911, were given as follows: Securities owned, $45,659,287; cash, $679,980; bills receivable, $786,000; accounts receivable, $257; accounts for expenses, $195; deposits for interest and dividends, $865,426; total, $47,991,146. Liabilities were: Preferred capital stock, $20,514,200; common capital stock, $16,250,600; eight-year 5-6 per cent collateral-trust gold bonds, $10,000,000; amounts due other companies, $318,687; interest and dividends due covered by special deposits, $865,426; profit and loss (surplus), $42,233.

Chicago Syndicate Buys 40,000 Shares of Pacific Gas & Electric Stock.—Samuel Insull, H. M. Byllesby and other Chicago capitalists have purchased 40,000 shares of Pacific Gas & Electric Company stock held by the estate of the late N. W. Halsey, at 62½. Mr. Insull will shortly become a member of the board of directors.

Hall Signal Reorganization.—It is expected that the plan for reorganization of the Hall Signal Company, upon which a committee has been at work for some time, will be agreed upon and made public before the end of March.

MARKET PRICES.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Allis-Chalmers	7/8	7/8	Mackay Companies..	81*	79½
Allis-Chalmers, pf..	4½	4	Mackay Cos., pf....	69¼	70*
Amalgamated Cop..	71	76½	Philadelphia Elec...	18⅛	18¼
Boston Edison.....	297½	298	Western Union.....	84¾†	83⅝
C'monwealth Edison.	147¾*	147	Westinghouse	74*	74½
Elec. Storage Bty..	55½	56⅛	Westinghouse, pf...	120¼*	120¼*
General Electric....	165	166¼			

*Last price quoted. †Ex-div.

Personal

Mr. Manfred A. Pakas has resigned from the Flour City Ornamental Iron Works, Minneapolis, Minn., to become Western agent for Gardiner's anti-rust paint.

Mr. Samuel Insull was elected chairman of the board of directors of the Federal Sign System (Electric) at a meeting of the board held in Chicago on March 15.

Dr. H. Austin Aikens delivered an address before the Electrical League of Cleveland on March 8, his subject being "The Aspects of Social Psychology." Dr. Aikens is professor of psychology at the Western Reserve University.

Mr. J. C. Matthieu, for several years assistant manager of the contract department of the Dayton Lighting Company, has been appointed to succeed Mr. B. H. Gardner, former contract agent, who recently removed to Glastonbury, Conn.

Mr. William C. Berry, of Chicago, claim agent of the Commonwealth Edison Company and vice-chairman of the company section of the National Electric Light Association, has made a satisfactory recovery after a serious surgical operation, and is again at his desk.

Mr. Frank D. Chase, architect of the Western Electric Company, has opened offices in the People's Gas Building, Chicago, for the practice of architecture and industrial engineering, making a specialty of manufacturing plants and mercantile buildings. Mr. Chase is a member of the American Society of Civil Engineers.

Mr. Louis A. Ferguson, second vice-president of the Commonwealth Edison Company, Chicago, has been made a member of the corporation of the Massachusetts Institute of Technology, of Boston. Mr. Ferguson, who is an alumnus, class of 1888, was elected to the corporation by the ballots of his fellow-alumni.

Mr. Henry M. Hobart has just finished a course of lectures before the senior class in electrical engineering at Union College, Schenectady, N. Y. The subject considered has been that of the design of alternating-current generators. Of special interest were the experimental data collected by Mr. Hobart with reference to the proper ventilation of alternators.

Mr. Ray Palmer was appointed city electrician of Chicago by Mayor Harrison on March 13. Mr. Palmer, who succeeds Mr. William Carroll, resigned, is an electrical engineering graduate of the University of Wisconsin, class of 1901. He has been a consulting engineer in Chicago and has made municipal investigations of electrolysis in Milwaukee and Chicago. The salary of the position is $6,500.

Mr. Charles T. Jaeger, general sales and factory manager of the Jaeger Miniature Lamp Company, has retired from active connection with the firm he founded fifteen years ago and built up to its present high standing. While Mr. Jaeger may continue to act in an advisory capacity, his future efforts will be principally devoted to research work and developing the industry from a manufacturing standpoint.

Mr. H. R. Setz, who has been chief engineer of the Struthers-Wells Company, of Warren, Pa., for the last two years, has accepted the position of chief engineer with the Otto Gas Engine Works of Philadelphia. Mr. Setz was formerly connected with several of the leading American and European gas and oil engine manufacturers. His particular attention will be directed toward the development of a complete line of Otto-Diesel engines of the horizontal type.

Mr. W. H. Thomson, Jr., general manager of the Des Moines (Ia.) Electric Company; Mr. George Peters, superintendent of the same company; Mr. C. W. Place, of the engineering department of the Chicago office of the General Electric Company, and a chauffeur were victims of a serious automobile accident in Des Moines on March 13. The machine was on or near a bridge crossing the Des Moines River when it came into collision with a railroad switch engine. Two of the occupants of the car were thrown to the riverbed below, and all of the members of the party were injured. Mr. Thomson suffered a dislocated hip, and one hand was badly bruised. He will be out of the hospital in about four weeks. Mr. Peters was injured in one foot so severely that amputation above the ankle was necessary. Mr. Place and the driver were also bruised and shaken up, but their injuries were of minor character, and both were out of the hospital in a few days. Mr. Thomson was until recently chief operating engineer of the Illinois Traction System, with headquarters in Peoria.

Obituary

Prof. Henry Wilson Spangler, head of the department of mechanical engineering at the University of Pennsylvania, died on March 18, following an illness extending over several years and which reached an acute stage several months ago. Dr. Spangler was born in Carlisle, Pa., on Jan. 18, 1858, and was graduated from the United States Naval Academy in 1878, where he had a brilliant career. During the four years he was a "star" member of his class, and the remarkable ability he showed is a tradition of that institution. He served in the United States Navy from 1878 to 1889, and has acted as a consulting engineer for the United States government since leaving the service. While in the navy he was detailed to the University of Pennsylvania as an instructor, and in 1889 resigned from the naval service to become professor of mechanical engineering at that institution. During his régime the course in mechanical engineering (which includes electrical engineering) was highly developed and enjoyed a high reputation abroad as well as in this country. Professor Spangler was a member of the Franklin Institute, the American Society of Mechanical Engineers, the American Society of Naval Architects, the American Society of Marine Engineers, the Society for the Promotion of Engineering Education, the American Philosophical Society and the Engineers' Club of Philadelphia, having served as president of the last named. He received the honorary degree of doctor of science from the University of Pennsylvania in 1900. Professor Spangler endeared himself to hosts of friends, by whom his loss is keenly felt.

Mr. Daniel D. Dickey, general manager of the National Carbon Company, as noted in this column last week, died at Cleveland March 8, as the result of an operation. The operation, which was performed on March 5 for an internal trouble, was considered successful, and although Mr. Dickey suffered a great deal on Tuesday afternoon and Wednesday, everything pointed to his speedy recovery, until Thursday, when complications arose, which increased and led to death the following day. Mr. Dickey, who was born at Pittsburgh, Pa., Oct. 9, 1853, attended the public schools of that city and later the Western University of Pennsylvania, now the University of Pittsburgh. At the time of his death Mr. Dickey was a patriarch in the carbon manufacturing business of the United States. In 1883 he acquired an interest in the Pittsburgh Carbon Company, and a few years later the plant was moved to Jeannette, Pa., and the name changed to Faraday Carbon Company. Mr. Dickey had a controlling interest in this company until the consolidation of several companies into the National Carbon Company of New Jersey in 1899, when he became a director and general manager of the consolidated companies, and moved to Cleveland from Pittsburgh. In his quiet, strong way he assisted in many ways in advancing the interests of his adopted city. He was a member of the Union, Country, Roadside and Rowfant Clubs and of the Cleveland Chamber of Commerce and the Chamber of Industry. By the employees of the National Carbon Company he was held in the greatest respect, not only as an officer but as a friend and helper. He made it a rule that the door of his office should never be closed. Employees and others went to him not only for instructions and guidance in business but for help in their personal affairs and troubles, and he was always ready to assist them in every way within his power. As a manager he never gave decisions hastily, but only after carefully considering all the facts and the wishes of everyone interested. He ruled by his personality and the respect which his employees had for him and his judgment rather than by his official title. He had a cheering word for every employee in his daily visits to the factory, for, in addition to directing the general business affairs of his company, he took direct charge of the manufacturing department. His friends and associates and every laboring man in his organization feel keenly his loss.

Construction

BIRMINGHAM, ALA.—Arrangements have been completed for the installation of the ornamental street-lighting system on Twentieth Street, posts for which have been ordered from the Union Foundry Co., Anniston. The construction work will be done by the Birmingham Ry., Lt. & Pwr. Co. The committee in charge of the work will submit the proposition of lighting Capitol Park to the City Commission at an early date.

FORT PAYNE, ALA.—Preparations are being made by the Little River Pwr. Co. for the erection of a large hydroelectric plant on Little River, near here. The plant complete will cost about $1,000,000.

GIRARD, ALA.—The City Council has entered into a contract with the Columbus R. R. Co. for the installation of 30 new street lamps to be installed immediately.

MOBILE, ALA.—The City Commissioners have entered into a contract with the Mobile El. Co. for the installation of 100 tungsten lamps to replace the 32-cp incandescent lamps now in use.

ARKADELPHIA, ARK.—Preparations are being made by the Southwestern Tel. Co. for rebuilding its local system, at a cost of about $50,000.

FORT SMITH, ARK.—The City Council has granted the Fort Smith Lt. & Pwr. Co. a franchise to extend its lines from Fort Smith to Van Buren over the new bridge recently opened.

GRAVETTE, ARK.—Plans are being prepared for the erection of a municipal electric-light plant and water-works system, to cost about $24,000, bids for construction of which will be received in about 30 days. Nagle & Peterson, Muskogee, Okla., are engineers.

McGEHEE, ARK.—Plans are being prepared by the Missouri Valley Engineering Co., Mitchell, S. D., for the installation of electric-light plant, water works and sewer systems in McGehee, bids for which will be asked for in the near future.

ALAMEDA, CAL.—Bids will soon be asked for the erection of electroliers in district No. 4.

ALHAMBRA, CAL.—The Home Tel. Co. has submitted a proposition to the Board of City Trustees to install a complete police signal system.

BAKERSFIELD, CAL.—The San Joaquin Lt. & Pwr. Co. has applied to the Board of Supervisors for a franchise to erect transmission lines on the roads and highways in the county of Kern for the transmission of electricity for lamps, heat and motors.

CHINO, CAL.—The city will receive bids for the construction of a 16-in. well with a 40-hp motor and pipe line. E. L. P. Wetmore is city clerk.

HANFORD, CAL.—The farmers in the Lakeside district are planning to erect an electric irrigating pumping plant, at a cost of about $50,000. Electricity for operating the plant will be supplied by the San Joaquin Lt. & Pwr. Co., Fresno.

ISLETON, CAL.—The substation of the Great Western Pwr. Co., located near here, was destroyed by fire causing a loss of about $10,000.

NEVADA CITY, CAL.—The Pacific Gas & El. Co. is planning to install 600 electric meters here, work on which will soon begin.

OXNARD, CAL.—A special election will be held April 5 to vote on the proposition to issue $40,000 in bonds for a municipal electric-light plant and water-works system.

PERRIS, CAL.—The Southern Sierra Pwr. Co. is planning to extend its power lines to Elsinore, via the Good Hope Mine.

PIEDMONT, CAL.—Preparations are being made for an extension of the Key Route railway from Oakland to San Jose, Cal. Additional equipment will be required to operate the new line.

POMONA, CAL.—The Home Tel. Co. contemplates the installation of a separate exchange in the Walnut district.

ROSEVILLE, CAL.—The City Trustees have received a proposition from the Pacific Gas & El. Co. offering to sell its local light and power plant to the city for $7,500.

SALINAS, CAL.—Work on the extension of the transmission line of the California Consol. Lt. & Pwr. Co. will soon be resumed. R. T. Davis is local manager.

SAN FRANCISCO, CAL.—The Universal El. & Gas Co. has notified the Board of Harbor Commissioners that it proposes to erect a large power plant on First and Barannon Streets.

SAN FRANCISCO, CAL.—The Southern Pacific Co. has decided to equip its system from Berkeley to Richmond and from San Leandro through Hayward to Niles for electrical operation. Work will begin within 60 days.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co. has purchased the property and holdings of the South San Francisco Lt. & Pwr. Co., which it proposes to operate as a new district to include all the power lines between Millbrae and the San Francisco-San Mateo county line. Frank P. Edwards, general manager of the local company, has been retained as district manager of the Pacific company.

STOCKTON, CAL.—An ordinance is being prepared by the city attorney which will require all public-service corporations using overhead wires to place their wires underground in the business district.

VISALIA, CAL.—Plans are being prepared for the installation of a new street-lighting system here. The plan calls for the erection of 100 lamps to be placed throughout the business and residence district.

WHEATLAND, CAL.—The Pacific Gas & El. Co. contemplates remodeling its entire plant here, work on which will soon begin. The company also plans the installation of a complete tungsten street-lighting system in Wheatland.

LONGMONT, COL.—District Judge Burke on March 7 handed down a decision granting the city of Longmont the right to build a municipal electric plant. The temporary injunction which was secured against the city by the Central Colorado Pwr. Co. being dissolved, the city will begin work immediately on construction of the plant.

MIDDLETOWN, CONN.—The Middletown El. Lt. Co. is planning to double the output of its plant. The work will include an addition to the power house, the installation of one or more boilers and a turbine engine. The capital stock of the company will be increased from $150,000 to $250,000.

NORWICH, CONN.—Contracts will soon be awarded by the Norwich & Westerly Ry. Co. for the construction of a 300-kw substation.

DAYTONA, BEACH, FLA.—The Schantz El., Ice & Water Co. has been granted a franchise to construct an electric-light system, water-works and ice plant here.

CUTHBERT, GA.—Arrangements are being made to begin work on improvements and extensions to the municipal electric-light plant and water-works system, to cost about $20,000. J. B. McCrary & Co., Atlanta, are engineers.

MACON, GA.—The Macon Ry. & Lt. Co. has awarded contracts for the construction of two substations in Macon.

MEIGS, GA.—At an election held recently the proposition to issue $15,000 in bonds for the installation of a municipal electric-light plant was carried.

NEWTON, GA.—The Council has engaged the Dysard Const. Co., Atlanta, to take charge of the construction of the municipal lighting system. The cost of the plant is estimated at $10,000.

CORY, IND.—The Citizens' Mutual Tel. Co. has decided to make extensive improvements to its system and will purchase considerable material and apparatus. E. Robertson is president.

FORTVILLE, IND.—The installation of a municipal electric-light plant is under consideration here.

HAZLETON, IND.—The Seager Engine Works, of Lansing, Mich., has submitted a proposition to the City Council offering to install an electric-light plant if granted a 25-year franchise and a 10-year contract for street lighting. The cost of lighting the streets is estimated at about $1,000 per year.

LAPORTE, IND.—The amalgamation of electric railway, light and power plants throughout the country by a syndicate headed by Samuel Insull, of Chicago, which includes the electric plant at Laporte, will result in extensive improvements and extensions to the local plant, which will be made this coming summer.

LEBANON, IND.—The Lebanon Hardware Co. is preparing to erect a large elevator, which will be equipped for electrical operation.

MUNCIE, IND.—The installation of cluster lamps in the business district is under consideration by the City Council.

PETERSBURG, IND.—The date for opening bids for lighting the streets, city buildings and other public places in the city and for a franchise for furnishing electricity for commercial and domestic use has been extended from March 7 to April 4. Specifications and further information may be obtained on application to the city clerk, Petersburg, or R. M. Case, consulting engineer, 48 Monument Place, Indianapolis, Ind.

PRINCETON, IND.—H. J. Peekingpaugh and others, of Evansville, have purchased the controlling interest of the Consumers' Gas & El. Co., of Princeton. The new owners have taken charge of the plant and announce that extensive improvements will be made to the system and new machinery installed.

ROCHESTER, IND.—Negotiations are under way whereby the Rochester El. Lt., Ht. & Pwr. Co. will extend its electric-lighting system to the cottages surrounding Lake Manitou.

SOUTH BEND, IND.—The contract for lighting equipment for the new high school building has been awarded to the Sanborn El. Co., Indianapolis, for about $6,000.

DENISON, IA.—The Denison El. Lt. & Pwr. Co. has applied to the Council for a 20-year extension to its franchise.

DES MOINES, IA.—The Fort Dodge, Des Moines & Southern R.R. Co. is planning to supply electricity to large industrial plants in or near the city. It is proposed to erect a separate transmission line from its power plant at Fraser to Fort Dodge. T. J. Richards will have charge of the power department.

DUBUQUE, IA.—The Dubuque Retail Merchants' Association has appointed a committee to secure signatures of property owners for the installation of ornamental street lamps on Clay and Main Streets, the cost of the installation to be paid by the property owners and the cost of maintenance by the lessee.

FOREST CITY, IA.—At an election held March 12 the proposition to grant the Forest City El. Lt. & Pwr. Co. a 25-year franchise was carried. The company already has a plant here. Frank Kellogg is president and manager.

FORT DODGE, IA.—The Fort Dodge Lt. & Pwr. Co. contemplates the installation of a steam-heating plant in conjunction with the electric plant.

GLENWOOD, IA.—The Glenwood El. Lt. & Pwr. Co. has applied to the Board of County Supervisors for a 25-year franchise to erect and maintain transmission lines over the county. The company is preparing to extend its service to Balfour, Hastings, Emerson, Henderson, Pacific Junction and probably Plattsmouth, Neb. A franchise has already been granted to the company in Emerson.

GRAVITY, IA.—At a special election held March 11 the Lee El. Lt. Co., Clarinda, Ia., was granted a 25-year franchise to operate an electric-light and power system here. The company was also given a 10-year contract for lighting the streets of the town, under the terms of which it will furnish 30 75-watt tungsten lamps. The service will be supplied from the Clarinda-Bedford transmission line of the company. Rufus E. Lee is manager.

HEDRICK, IA.—J. O. Ruggles is interested in a project to establish an electric light and power plant here.

LISBON, IA.—The municipal electric-light plant has been purchased by W. S. Tasker.

MOVILLE, IA.—At an election to be held March 25 the proposition to install an electric-light system will be submitted to a vote.

POMEROY, IA.—The installation of a municipal electric light and power plant here is under consideration.

KANSAS CITY, KAN.—The city has decided to install 109 ornamental concrete lamp standards in Swope Park, at a cost of $7,000.

MANHATTAN, KAN.—The Manhattan City & Interurban Ry. Co. will place contracts for the construction of a new power house during the next 30 days. Orders have been placed for an oil engine and General Electric generator.

MINERAL, KAN.—The City Council will probably call an election to submit the proposition to issue $10,000 in bonds for municipal light and water plants to the voters.

OLATHE, KAN.—Sealed proposals will be received by the State Board of Control, Topeka, Kan., until May 7 for the installation of a 30-kw direct-current generator attached to a 50-hp side-crank high-speed engine for the School for the Deaf, Olathe, Kan., in accordance with plans and specifications prepared by Charles H. Chandler, state architect. Charles W. Gibbs is secretary of board.

CORYDON, KY.—The Council is considering the question of issuing bonds for the installation of an electric-light plant. Arrangements may be made with the Cahaba Coal Co. whereby it will operate an electric plant in connection with its works.

CRAB ORCHARD, KY.—Preparations are being made by Edmund H. Anderson, Nicholasville, Ky., for the installation of electric and cold-storage plants at Crab Orchard Springs. The electric plant will have sufficient output to maintain 1200 lamps and the ice plant an output of 4 tons per day. Later a steam-heating plant for heating the building will be installed.

GREENVILLE, KY.—Plans are being considered by J. A. Rose, engineer of the Greenville Lt. & Wtr. Co., for the construction of an electric railway from Greenville to Central City. The project includes the construction of a power house at some point between the two cities which would supply electricity to operate the proposed railway and for the coal mines in Western Kentucky.

JENKINS, KY.—The Consolidated Coal Co., Baltimore, Md., which is establishing several industrial towns in Eastern Kentucky for the development of its coal lands in that section, is erecting a power plant in Jenkins, the first of the communities established. The plant will supply electricity in Jenkins and to other towns, including McRoberts.

TYLERTOWN, LA.—The Mayor and Board of Aldermen have granted J. C. Flippen and C. H. Stevens a franchise to construct and operate an electric-light system here. Work will begin on construction of the proposed plant at once.

VILLE PLATTE, LA.—L. J. Dossman, Opelousas, has been granted a franchise by the municipality to install an electric-light system and ice plant.

PORTLAND, MAINE—Work will soon begin on the erection of ornamental lamp standards, to continue the cluster-lamp system on Congress Street from Market Street easterly to Washington Avenue and from Congress Square westerly as far as St. John Street.

WISCASSET, MAINE.—The proposition to light the streets of the village by electricity will be submitted to a vote.

AUBURN, MASS.—The proposition to raise money to light some of the public streets and to equip the town hall for electric lamps will be submitted to a vote at the next annual town meeting.

BALDWINSVILLE, MASS.—The citizens have voted to appropriate $4,125 for extensions to the municipal electric-light system in different parts of the town. Post office address, Templeton.

BOSTON, MASS.—A mandatory bill has been reported by the legislative committee on railroads to the Legislature providing for the electrification of all railroads entering Boston. The bill provides that all railroads within the metropolitan park system shall be operated by electricity. The park system has a radius of about 15 miles from the State House. The railroads, under the bill reported, are given until 1920 to make the changes required.

BROCKTON, MASS.—Plans have been prepared for the installation of cluster tungsten lamps on Main Street. The expense of the installation is to be paid by the merchants and property holders and the cost of maintenance to be borne by the city.

DIGHTON, MASS.—The Selectmen will submit to the voters the question of allowing the electric-light companies of Fall River and Taunton to erect transmission lines in this town to supply electricity for lamps and motors. If the proposition carries, the Taunton municipal electric plant would supply the north section of the town and the south section would secure its service from the Fall River El. Lt. Co.

GLOUCESTER, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Gloucester El. Co. permission to issue $75,000 in additional capital stock, the proceeds to be used to provide for expenditures already made and for extension of its lines into Essex, placing its wires underground in Gloucester and for additions to its generating plant.

PALMER, MASS.—The New England Investment & Security Co. has sold all its interests in the Central Massachusetts Co., Palmer, except those pertaining to the transportation business. The officers of the new management are: E. P. Rowell, treasurer of the Plymouth El. Lt. Co., Plymouth; Charles R. Adams, Boston, Mass., treasurer, and H. M. Parsons, general manager. The new management expects to make many improvements to the system to enable the company to improve its service here and in neighboring towns. Tungsten lamps will be used for street lighting. The company now operates in Palmer, Monson, Wilbraham, Three Rivers, Thorndike, Warren, West Warren and West Brookfield.

TAUNTON, MASS.—The City Council is considering the question of extending the electric transmission line to the north end of the city to supply electricity for lamps to the residents on West Britannia Street and the Reed & Barton works.

GRAND RAPIDS, MICH.—Sealed proposals will be received at the office of the Board of Public Works until March 28 for transporting and erecting pumps, piping, motors, transformers and crane for the East Side sewage pumping station. Samuel A. Freshney is secretary and general manager.

GRANT, MICH.—The Grand Rapids-Muskegon Pwr. Co. has applied for a franchise to supply electricity here. If granted a franchise, it is understood that the company will extend its transmission line from Kent City.

KALAMAZOO, MICH.—At an election to be held April 1 the proposition to issue $140,000 in bonds for the installation of a municipal electric-light plant will be submitted to a vote. H. A. Johnston is city engineer.

KENT CITY, MICH.—The Grand Rapids-Muskegon Pwr. Co. is planning to erect a substation in Kent.

GOOD THUNDER, MINN.—The erection of an electric-light plant here is under consideration. The Consumers' Pwr. Co. has applied for a franchise to operate in Good Thunder.

ROSEAU, MINN.—Application has been made to the town by S. F. Benaime and others for a franchise to install and operate an electric-light plant here.

VIRGINIA, MINN.—The Mesaba Range Trac. Co. is negotiating with the Virginia & Rainy Lake Co., Virginia, for a site for its proposed power plant and for fuel. The traction company proposes to utilize waste from the sawmills of the Rainy Lake Company for fuel. The new power plant will be of steel construction, 100 x 200 ft., and will be equipped with four 150-hp boilers and two low-pressure turbines of 750 kw each. The Mesaba Range Trac. Co. will connect half a dozen Mesaba Range towns and cities.

BURWELL, NEB.—The Burwell El. Co. is planning to build an electric light and power plant here, work on which will begin in the near future. The company has applied for a franchise in Ord and if granted will supply electrical service from the Burwell plant. The company is capitalized at $75,000, and the officers are: Ira V. Reasoner, president; H. A. Reese, vice-president, and C. O. Beardsley, treasurer.

MORSE BLUFF, NEB.—Preparations are being made to install the new electric-light plant, which will be located in the basement of the city hall. Engine and dynamo for the proposed plant have already been purchased.

GOLDFIELD, NEV.—Electric hoists will be installed at the Booth and Blue Bull Mines at once.

LEBANON, N. H.—The Lebanon El. Lt. & Pwr. Co. is in the market for electric fixtures for the new hotel at Lebanon, the cost of which is estimated at about $400. H. M. Tucker is superintendent.

FREEHOLD, N. J.—The Freehold Merchants' Association has adopted a resolution to engage an electrical engineer to make investigations and submit data as to the probable cost of establishing a municipal lighting plant here.

MONTCLAIR, N. J.—The Town Council has granted the United Elec. Co. of New Jersey a 25-year franchise to supply electricity in this town. The company agrees to place the wires on Bloomfield Avenue in underground conduits and to expend $10,000 every year to place its wires in conduits. The ordinance further provides that the town has the right to purchase all of the property of the company located in Montclair with the exception of the power house at the end of ten years, the price to be fixed by arbitration.

MOUNT HOLLY, N. J.—Steps have been taken by the Mount Holly Township Committee to ascertain the cost of installing and maintaining a municipal electric-light plant.

ORANGE, N. J.—The City Council is considering the question of installing a commercial lighting service. The municipal electric plant now furnishes only street lighting service.

PATERSON, N. J.—Plans are being considered by the Society for the Establishment of Useful Manufactures to develop the water-power of Passaic Falls, to generate electricity for lamps and motors, and for the installation of an auxiliary steam plant for use during the low-water periods. The society proposes to provide electricity to light and operate the mills and factories at present using the water-power of the raceways and also for the factories and mills which will probably be erected on the site of what was once Morris Mountain. John H. Cooke, hydraulic engineer, will have charge of the work.

WAGON MOUND, N. M.—Henry Shaw, Las Vegas, N. M., has been granted a franchise to construct and operate an electric-light plant in this place.

ALBANY, N. Y.—The contract for electric wiring the high school has been awarded to the E. K. Comstock Co., New York, N. Y., at $29,700, and that for plumbing, gas and vacuum equipment to A. J. Eckert Co., Albany, at $26,880.

BUFFALO, N. Y.—The Western New York Wtr. Co., Buffalo, which is building a new pumping and filtration plant at Niagara Falls, has decided to equip the plant with electrically driven pumps.

CANASTOTA, N. Y.—The Village Board has awarded a contract to the Central New York Pwr. Co. for street lighting at $5,484 per year, under which the company is to furnish 58 arc lamps as at present and 63 40-watt tungsten lamps at $18 each per year, to replace the incandescent lamps now in use.

NEW YORK, N. Y.—The Consolidated Gas Co., acting for its subsidiary, the United El. Lt. & Pwr. Co., has awarded the contract for steel work for the new power house to be erected on 201st Street. The cost of the entire plant is estimated at about $8,000,000 and is to be finished in about two years.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner Park Avenue and Fifty-ninth Street, New York, until March 25 for installing electric equipment in new Public School 47, on Randolph Avenue, borough of the Bronx. Blank forms, plans and specifications may be obtained at the above office.

NEW YORK, N. Y.—Sealed bids will be received by George McAneny, president of the borough of Manhattan, Room 14, City Hall, New York, until March 29, for furnishing material and installing electric-lighting system, fixtures and wiring complete in the Washington Market building, borough of Manhattan. Blank forms and specifications may be obtained at the office of the auditor, offices of the Commissioner of Public Works, 13 to 21 Park Row, borough of Manhattan.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, until March 28 for providing all labor and materials required for the inspection and maintenance of electrical apparatus in the boroughs of Manhattan, the Bronx, Brooklyn, Queens and Richmond, for the Department of Public Charities. Blank forms and further information may be obtained at the office of the supervising engineer of the department, foot of East Twenty-sixth Street, New York, where plans and specifications may be seen. Michael J. Drummond is commissioner.

ROCHESTER, N. Y.—Plans are being prepared by the Rochester Ry. & Lt. Co. for the erection of a new power station in the eastern section of the city to supply electricity for lamps and motors.

SENECA FALLS, N. Y.—The question of extending the ornamental lighting system on State Street from Fall Street to the New York Central depot is under consideration.

SYRACUSE, N. Y.—The Public Service Commission, Second District, has authorized the Syracuse, Watertown & St. Lawrence River R. R. Co. to issue a mortgage upon all its property, rights and franchises to secure an issue of bonds to the amount of $1,000,000. The company is authorized at this time to issue $200,000 in bonds, to be sold at not less than 80; also its capital stock to the amount, par value, of $100,000, the proceeds to be used for the construction of its railway, about 6.2 miles long, and also for legal, organization and interest expenses.

UTICA, N. Y.—The Utica Park Board has decided to ask the City Council for a bond issue of $95,000 for the continuation of the boulevard easterly from Mohawk Street to Thomas R. Proctor Park, for lighting the boulevard at all street intersections and for building various roads in Roscoe Conkling Park.

CHARLOTTE, N. C.—C. W. Johnston, president of the Highland Park Mfg. Co., Charlotte, N. C., is in the market for a 250-kw, 2300-volt, three-phase, 60-cycle, 450 r.p.m. second-hand generator, rope-driven; also direct-connected engine and generator of same rating as above.

LEWISVILLE, N. C.—N. E. Whitman is contemplating installing an electric-light plant in Lewisville.

MOUNT HOLLY, N. C.—The Southern Pwr. Co. will soon award contracts for the erection of a new substation in Mount Holly. The proposed station will have an output of 10,000 hp and will cost about $100,000. Contracts for equipment have already been placed.

STIGLER, N. C.—At an election to be held April 2 the proposition to issue $25,000 in bonds to purchase a light plant will be submitted to a vote.

WADESBORO, N. C.—The municipal electric-light plant has been purchased by the Yadkin River Pwr. Co., which owns the Blewitt Falls hydroelectric plant in North Carolina, for $15,000, on condition that energy is to be furnished to this city as cheaply as any other point in the State.

HATTON, N. D.—At an election held recently the proposition to issue bonds for the erection of a municipal light plant was carried.

NORTHWOOD, N. D.—An election will be held in April to vote on the proposition to issue $9,000 in bonds to construct a municipal electric-light plant. G. P. Johnson is city auditor.

DEFIANCE, OHIO.—The City Council has granted the Defiance Utilities Co. a 25-year franchise to furnish electricity here. The company will secure electricity from the power plant on the Auglaize River.

GRANVILLE, OHIO.—The Town Council is considering the question of installing a new municipal electric-light plant.

MANSFIELD, OHIO.—Plans and estimates have been submitted by E. A. Merkel, city engineer, for the establishment of a municipal electric-light plant here. The cost of the power plant is estimated at $58,200 and that of the lighting system at $74,570, making a total of $132,770. The plans provide for the installation of a 600-kw plant in connection with the pumping station. The lighting system calls for 270 ornamental concrete posts, carrying five-lamp clusters each, for the business district, 1000 three-lamp clusters for the residence section and 200 single lamp-posts in the outlying districts.

WELLSVILLE, OHIO.—The Council has adopted a resolution to provide funds to secure the services of an electrical engineer to prepare estimates and plans as to the cost of establishing a municipal electric-light plant in Wellsville.

WEST MILTON, OHIO.—The Dayton, Covington & Piqua Trac. Co. contemplates the purchase of a new 150-kw generator for its West Milton station. Two 150-hp boilers will also be installed in the power house here.

YOUNGSTOWN, OHIO.—Sealed bids will be received by the director of public safety, Youngstown, until March 28 for furnishing 3680 ft. of 25-wire cable and 1000 ft. of 6-wire cable, according to plans and specifications on file in the office of the director of public safety. N. McVey is clerk.

KINGFISHER, OKLA.—Plans and specifications are being prepared by the Benham Engr. Co., consulting engineer, Oklahoma City, Okla., for the installation of an electric-light plant here. Bids will soon be asked for construction of the plant.

FLORENCE, ORE.—Application has been made to the Town Council by G. G. Bushman for an electric-light and power franchise in Florence.

PENDLETON, ORE.—The Council has appointed a committee to investigate the water-power rights on the Walla Walla River near Milton about 20 miles above here, with a view of developing same to supply power to operate a municipal electric-light plant. It is estimated that about 2000 hp could be developed, at a cost of about $125,000. John Dyer is a member of the committee.

PORTLAND, ORE.—The Oregon El. Ry. Co. will soon begin work on its proposed extension from Salem to Eugene. C. A. Coolidge is manager.

PORTLAND, ORE.—The Southern Pacific Co. has decided to equip its railway west of the Willamette River for electrical operation and to establish an interurban system. The cost of the work is estimated at about $500,000 and will include the construction of carhouses, freight sheds and additional depots in and around Portland.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., and at the office of the assistant purchasing agent, 1086 North Pine Street, San Francisco, Cal., until April 3, 1912, for furnishing electric cable during the period of 15 months beginning April 3, 1912. Blanks and general information relating to this circular (No. 695) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

INTERCOURSE, PA.—The Intercourse El. Lt., Ht. & Pwr. Co. has filed an application with the State Department at Harrisburg for permission to increase its capital stock from $6,000 to $25,000. E. K. Denlinger is president and Enos L. Zimmerman secretary and treasurer.

MEADVILLE, PA.—Sealed proposals will be received at the office of the Water and Light Department, Meadville, until March 30, for furnishing equipment for a pneumatic water system, consisting of a pneumatic tank, pumps, electric motors, automatic starting and stopping devices, etc. For further information address Harry Ellsworth, superintendent.

PHILADELPHIA, PA.—Automatic signals are to be installed on 111 miles of the main line of the Pennsylvania Railroad between Latrobe and Summerhill. Electro-pneumatic signals are to be used.

SCHUYLKILL HAVEN, PA.—Plans are being considered by the light committee of the Council for improvements to the street-lighting system on Main Street. It is proposed to replace the arc lamps with incandescent lamps.

SHARON, PA.—The Borough Council has passed an ordinance authorizing an issue of bonds to the amount of $85,000 for the construction of a municipal electric-light plant, subject to the approval of the voters.

PROVIDENCE, R. I.—A bill has been introduced into the State Legislature asking for a charter for the Rhode Island Pwr. Trans. Co. The company will be capitalized at $500,000 and proposes to supply electricity for lamps, heat and motors in this State. The incorporators are Jonathan Chace, Walter Callender, Malcolm G. Chace, John O. Ames, Henry I. Harriman, Philip Young, Herbert F. H. Hinckley and Frank L. Hinckley.

BARNWELL, S. C.—A petition has been presented to the Town Council asking that an election be called to vote on the proposition to issue bonds for the installation of a municipal electric-light plant and waterworks system. Preliminary steps are now being taken to ascertain the cost of establishing a plant, etc.

FLORENCE, S. C.—The Council is considering the question of submitting the proposition to issue $35,000 in bonds for the construction of a municipal electric-light plant to the voters. William J. Wilkins is chairman of Board of Public Works.

LAKE CITY, S. C.—The Deep Creek Lumber Co., Norfolk, Va., is reported to be contemplating the installation of an electric light and power plant near here.

ROCK HILL, S. C.—The Virginia-Carolina Pwr. Co., recently incorporated, proposes to develop about 25,000 hp on the Roanoke River near Weldon, N. C. William C. Whitner, Rock Hill, is president.

WATERLOO, S. C.—The Town Council has appointed a committee to investigate the matter of installing an electric-light plant. D. B. Black is a member of the committee.

CORSICA, S. D.—It is reported that local capitalists are preparing to install an electric-light plant here.

LEAD, S. D.—The City Council has decided to install cluster lamps in the business section of the city.

LENNOX, S. D.—Steps have been taken to form a stock company to install an electric-light plant here. L. Greenfield is interested in the project.

ROSSVILLE, TENN.—The City Council has granted the Chattanooga Ry. & Lt. Co. a franchise to erect transmission lines to supply electricity here. Energy for operating the system will be transmitted from the Ocoee River plant.

FORT WORTH, TEX.—The Northern Texas Trac. Co. has increased its capital stock from $4,500,000 to $6,000,000. The company operates the Dallas-Fort Worth interurban railway.

LOTT, TEX.—The Lott El. Co. has commenced work on the erection of its new plant on a new site and is rebuilding its main wires.

NACOGDOCHES, TEX.—An election will soon be held to vote on the proposition to issue $65,000 in bonds, of which the proceeds of $20,000 will be used for an electric-lighting system. George H. Matthews is Mayor.

SAN ANTONIO, TEX.—Plans are being considered by several business men in San Antonio with a view of organizing a company to cooperate with the Colorado Pwr. Co. in the establishment of electric-power plans and the transmission of electricity for factories here. The proposed transmission line will be about 90 miles long.

MIDDLEBURY, VT.—The building committee of the Middlebury College has awarded H. S. Libbey & Co., Boston, Mass., the contract for the erection of the power house for the central heating plant. The power house will be 45 ft. square and will be equipped with two boilers manufactured by the D. M. Dillon Iron Works, Fitchburg, Mass. The power house will be large enough to accommodate five boilers and also an electric-light plant. The total cost of the plant is estimated at about $25,000.

CENTRALIA, WASH.—The Centralia El. Lt. & Trac. Co. has been granted a right-of-way through the city by the City Commissioners. The company was recently organized to build an electric railway between this city and Rochester. The power house of the company has been completed and equipped and work will begin on construction of the railway about April 1.

LOON LAKE, WASH.—The installation of an electric-light system here is under consideration. John Kulzer is interested in the project.

PORT TOWNSEND, WASH.—The Key City Lt. & Pwr. Co. is planning to erect a substation for the purpose of transforming the current from the high-tension lines of the Olympia Pwr. Co. The cost of the work is estimated at between $6,000 and $7,000. M. T. Crawford is in charge of the work.

SEATTLE, WASH.—A bill has been introduced by the city lighting department to the City Council asking for an appropriation of $200,000 from the lighting fund for the construction of a steam power plant on Lake Union at the foot of Nelson Street.

VALLEY, WASH.—John Kulzer, owner of the local electric-light system, contemplates extending his transmission lines to Loon Lake.

WASHOUGAL, WASH.—The Western Lt. & Pwr. Co. has applied to the County Commissioners of Fern County for permission to erect transmission lines along the county roads for the purpose of supplying electricity for lamps and motors to the farmers living on Fern Prairie and other communities near Washougal.

FAIRMONT, W. VA.—The Monongahela Trac. Co. has been organized to take over the properties of the Fairmont & Clarksburg Trac. Co., the Fairmont & Northern Trac. Co. and the Clarksburg & Western El. Ry. Co. The new company will have an authorized bond issue of $15,000,000.

PARKERSBURG, W. VA.—The installation of a boulevard street lighting system in the business district is under consideration.

EAU CLAIRE, WIS.—The Chippewa Valley Ry., Lt. & Pwr. Co. contemplates erecting a substation here during the coming summer.

MINERAL POINT, WIS.—The Mineral Point El. Lt. Co. has secured a franchise to extend its transmision lines from Linden to Livingston, Mifflin, Rewey, Montfort, Highland, Cobb, Edmund and back to Linden and Mineral Spring.

BAGGS, WYO.—A franchise has been granted to C. C. Cunningham, Jr., to construct and operate an electric light and power plant in Baggs.

VANCOUVER, B. C., CAN.—Plans are being considered by the City Council for the installation of 200 additional arc lamps throughout the city and also a number of ornamental street lamps.

BRANDON, MAN., CAN.—The City Council has decided to negotiate with the Brandon El. Co. for the purchase of its plant.

LEAMINGTON, ONT., CAN.—The Leamington Lt. & Ht. Co., Ltd., is seeking a franchise from the Gosfield North Council to erect lines across that township to transmit electricity from here to Essex. The company owns plants at Leamington, Kingsville, Essex, Harrow, Amherstburg and Sandwich. It is proposed to enlarge the plant here and discard the power stations in Essex and Kingsville, supplying electricity from the plant here to operate the systems in these two places. Amherstburg and Harrow will be supplied from the Sandwich plant.

ST. MARY'S, ONT., CAN.—The St. Mary's Cement Co. has entered into a contract whereby its plant will be operated by electricity in the future supplied by the Hydro-Electric Power Commission. The cost of the transmission line and transformers is estimated at $15,000.

THORNDALE, ONT., CAN.—A by-law providing for contracting with the Hydro-Electric Power Commission for electricity for lamps and motors here will be submitted to the ratepayers at an early date.

WEST TORONTO, ONT., CAN.—The Toronto El. Lt. Co. has been granted permission to erect transmission lines on certain streets in this township.

New Industrial Companies

THE BRIDGETON CHANDELIER COMPANY, Bridgeton, N. J., has been incorporated by J. Lenrart Rice, Wallace C. Rice, Jesse D. Reeves, LeRoy N. Sutton and LeRoy M. Felmey, all of Bridgeton. The company is capitalized at $100,000 and proposes to manufacture chandeliers, gas fixtures, electric-light fixtures, etc.

THE CENTRAL NEW YORK ENGINEERING & EQUIPMENT COMPANY, of Geneva, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing electrical and mechanical equipment, engines, etc. The directors are: J. H. Sharp, Geneva, and M. H. Bowers, Penn Yan, N. Y.

THE ELECTRIC AUTOMATIC INDICATOR & ADVERTISING COMPANY, LTD., of San Francisco, Cal., has been incorporated with a capital stock of $100,000 by R. Elder, J. P. Court and H. Steinmetz.

THE ERIE ELECTRIC CONTRACTING COMPANY, of Bridgeport, Conn., has been chartered with a capital stock of $1,000 by James A. Byrne, Daniel P. Reighemimer and Peter C. Schutrum.

THE GIBSON ELECTRIC MOTOR STARTER COMPANY, of Indianapolis, Ind., has been incorporated by R. K. Allison, B. Gilson, C. W. Mabey and R. B. Allison to manufacture and sell motor starters and speeders and also motor primers, exhilarators, valves and other appliances.

THE HALE ELECTRIC & ENGINEERING COMPANY, of Cleveland, Ohio, has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing electric motors, etc., by Willis W. Hale, J. C. Anderson, Willis B. Hale, E. C. Reader and C. C. Hale.

THE INDEPENDENT ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has been incorporated by Ralph A. Levene, Joseph Mayer and Felix Cornetius. The company is capitalized at $10,000 and proposes to deal in general electrical supplies.

THE PERRY MANUFACTURING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $350,000 to manufacture railway apparatus, equipment, hardware, etc. The incorporators are: A. L. Drayton, M. J. Currie and G. J. Fermier, Jersey City, N. J.

THE REESE SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Llewellyn Reese, Stamford, Conn.; Montague Lee, Brooklyn, N. Y., and H. H. Boyesen, New York, N. Y. The company proposes to deal in electric-light fixtures.

THE SWISS MAGNETO COMPANY, of Buffalo, N. Y., has been granted a charter with a capital stock of $250,000 for the purpose of manufacturing magnetos, ignition apparatus, etc. The incorporators are: H. S. Martin, Dunkirk; B. H. Phillips and E. C. Schlenker, Buffalo, N. Y.

New Incorporations

LOS ANGELES, CAL.—The Mountain Pwr. Co. has been incorporated with a capital stock of $1,500,000 by Fred P. Brewer, Carrie M. Owen, John S. Owen and Frank D. Stout.

LOS ANGELES, CAL.—The Santa Barbara & Suburban Ry. Co. has applied for a charter to build an electric railway. The company is to be capitalized at $750,000. The incorporators are: A. A. Maxwell, Los Angeles; L. J. Lee, Pasadena; William Dieterie, E. A. Murphy and Herbert F. Keenan.

ROSEVILLE, CAL.—The Roseville Watr. Co. has been incorporated with a capital stock of $200,000 for the purpose of supplying water, water-power and electricity in towns and cities in California.

SAN FRANCISCO, CAL.—The Mount Shasta Pwr. Co. has been incorporated with a capital stock of $10,000,000 for the purpose of developing the water-power of the Pitt River to generate electricity. A 7-mile tunnel is being bored in the Pitt River country in connection with the development work. The cost of the entire project is estimated at $16,000,000. The company proposes to compete in the light and power field in California and will enter San Francisco eventually. The incorporators are: Charles L. Firebaugh, Joseph Haber, Jr., A. M. Moore and Edgar Sinsheimer. Lilienthal, McKinstry & Raymond are attorneys.

HARTFORD, CONN.—The Gas & El. Imp. Corpn. has been incorporated with a capital stock of $45,000,000 by Lucius F. Robinson, John T. Robinson and F. W. Cole. Berton, Griscom & Jenks, of New York, are said to be interested in the company.

NEZPERCE, IDAHO.—The Lewis County Pwr. Co. has been incorporated by A. Welch and R. B. Montague, of Portland, Ore., to develop 125,000 hp on the Salmon River. The plans provide for the construction of a 200-ft. dam across Salmon River at the point of the intake, driving of necessary tunnels and the installation of electrical equipment and erection of transmission lines. The cost of the development complete is estimated at about $4,000,000.

CHICAGO, ILL.—The Elgin Terminal Ry. Co. has been incorporated with a capital stock of $2,500 to operate a railway through the counties of Will, Kendall, Cook and Lake to a point in Lake County. The incorporators are: D. C. Dunlap, C. F. Dunlap, Henry L. Rich, Robert S. McCreadie and C. A. Bergtold, all of Chicago.

INDIANAPOLIS, IND.—The Indianapolis, Newcastle & Northeastern Trac. Co. has been incorporated with a capital stock of $10,000 for the purpose of building an extension of the Indianapolis and Newcastle railway from Newcastle to Muncie and to furnish electricity to towns and cities along the car line. Joseph T. Elliott & Sons and J. H. Hornbrook are interested in the project.

SACO, MAINE.—The Macoris Lt. & Pwr. Co. has been incorporated with a capital stock of $100,000 to generate and distribute electricity for lamps, heat and motors. J. C. Smith, of Saco, is president, and H. L. Whitney, of Biddeford, treasurer.

SOUTHPORT, N. C.—The Southport Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000 by E. K. White, C. E. Taylor and Henry P. O'Hagan. The company proposes to do a general electric-lighting and power business.

WILLIAMSTON, N. C.—The Williamston El. Co. has been incorporated by W. C. Manning, J. W. Manning and W. C. Manning, Jr. The company is capitalized at $25,000 and proposes to supply electrictiy, fuel and ice.

DAYTON, OHIO.—The Hetzel Ltg. & Htg. Co. has been incorporated with a capital stock of $5,000 by F. Hetzel and others for the purpose of supplying electricity and steam heating.

LIBERTY CENTER, OHIO.—The Liberty Lt. & Pwr. Co. has been incorporated with a capital stock of $6,000 for the purpose of supplying electricity for lamps, heat and motors. The incorporators are: C. B. Kerschner, E. J. Finn, E. W. Costello, W. P. Wallace and H. A. Spangler.

NEW PHILADELPHIA, OHIO.—The Wise-Harrold El. Co. has been incorporated with a capital stock of $30,000 by W. J. Wise, Albert E. Wise, H. H. Harrold, Charles Lentz and T. B. Stroup.

ELK CITY, OKLA.—The Elk City Lt. & Pwr. Co. has been incorporated with a capital stock of $30,000 by J. M. Bonham, D. M. Brenneman and Walter Goodhue.

WILBURTON, OKLA.—The Wilburton-McConnell Lt. & Pwr. Co. has been incorporated with a capital stock of $12,000 by James McConnell, Mary A. McConnell and M. A. Degnan.

HARRISBURG, PA.—Charters have been granted by the State Department to the Milesburg, Howard and Unionville El. Cos. to operate in towns of those names in Centre County. Each company is capitalized at $5,000, and the incorporators are: A. W. Lee, A. J. Musser and J. W. Clearfield, all of Clearfield. The main offices of the companies will be located in Bellefonte, Pa.

HENDERSON, TENN.—The Priestly-Lloyd Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by C. W. Priestly, P. R. Priestly, J. H. Priestly and A. C. Lloyd, Jr.

LEONARD, TEX.—The Leonard Ice & Lt. Co. has been incorporated with a capital stock of $25,000 by H. T. Weathers, J. C. Christian and J. R. Wilson.

Trade Publications

MOLONEY TRANSFORMERS.—The Moloney Electric Company, of St. Louis, Mo., and Windsor, Canada, has just issued a four-page folder with illustrations and information covering the Moloney "high efficiency" transformers in sizes from 1 kva to 5000 kva up to 110,000 volts.

CONDUIT FITTINGS.—The Appleton Electric Company, of Chicago, is distributing a new 84-page catalogue, which covers in detail all the material manufactured by the company. The Appleton people make a specialty of sherardizing their fittings and have many new features in the line of stamped steel unilets which should be of interest to engineers and electrical contractors throughout the country.

APPLICATION OF ELECTRICITY TO MARINE SERVICE.—Bulletin No. 4926, just issued by the General Electric Company, and which is printed in colors, describes the various pieces of apparatus and supplies manufactured by this company for marine use and contains data of general interest to motorboat owners. Among these data will be found reproductions in colors of the flags of the principal yacht clubs throughout the country.

MARINE LIGHTING.—Mr. Clark Baker, of the Brilliant Electric Company, of Cleveland, Ohio, has compiled in bulletin form data with reference to marine lighting, in which the illumination of modern steel ore boats especially is considered in detail. Attention is called to the necessity of equipping lamps for this class of service with suitable reflectors, and a detailed description of a complete unit designed by the Brilliant Electric Company with the co-operation of the American Ship Building Company is presented. Sectional drawings of a vertical reflector unit and an angle reflector unit are shown. The lighting conditions on board passenger boats are also discussed, and methods of lighting the cabins, officers' quarters, passages, staterooms, etc., are suggested. The bulletin is well illustrated throughout.

INTERCHANGEABLE FIXTURES.—The Tungstolier Company, of Conneaut, Ohio, has developed an ingenious catalog device to demonstrate the principle of its sectional lighting unit, with interchangeable parts. This catalog is made up of sheets on which are reproduced the full line of fixtures, each complete fixture occupying a full sheet. The sheets are gummed and bound on all four sides, and then so cut that each of the various sections of each fixture—stems, arms, bodies and canopies—is on a separate segment of the sheet or page. By lifting up these segments any combination of parts can be readily produced and studied. With a set of eighty-six fixture parts it is possible to build up 1944 different and distinct fixture combinations. Every one of these combinations can be effected and compared by the manipulation of this new sectional catalog, and the salesman can practically demonstrate the entire line, in all its variations, by simply interesting the customer in this book.

A HANDSOME CATALOG OF GLASS SHADES.—The Opalux Company, 258 Broadway, New York, has issued in bound form a catalogue de luxe of opalux and other shades which is a credit to all concerned in its execution. The various sections have a handsome initial page, and the binding, though relatively inexpensive, would be appropriate for a pretentious book of literary character. Much information relating to illuminating engineering appears in the various sections; the final section is entirely devoted to illuminating-enginering data, and one section treats wholly of the science of light. Many excellent full-page illustrations are given of fixtures, in which various types of shades are displayed to advantage. In addition to "Opalux" shades, there are illustrations and descriptions of "Carrara," "Gletieco" and "Camia" reflectors—European types for which the Opalux Company is the American selling agent. In the part of the book giving commercial data each type of shade illustrated is accompanied with a photometric curve.

SYNCHRONOUS MOTORS FOR POWER-FACTOR CORRECTION.—With this title the railway and lighting department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a booklet, in an art cover, containing data on the phenomena of power-factor, the bad effects of very low power-factor, and on power-factor correction with synchronous motors. Besides a discussion of power-factor and its correction, by Nicholas Stahl, the publication gives many specific data on and illustrates many synchronous motor installations made for improving low power-factors. Curves and diagrams are given whereby one can determine with a few simple calculations the capacity of a synchronous motor necessary to correct a given load from and to given power-factors. Directions and diagrams are given for solving by inspection the other problems that arise in connection with power-factor phenomena. One feature of the booklet that will be appreciated by practical engineers is the simplicity of the treatment of the many examples illustrating the use of the data and curves.

Business Notes

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburgh, Pa., has moved from its old location and now occupies the entire ten-story building at 711-713 Liberty Street. The new location has over 35,000 sq. ft. of available floor space and will permit of contemplated expansion of business activities.

KANAWHA ELECTRICAL ENGINEERING COMPANY.—Messrs. E. A. Fruth and H. E. Bek have opened an office and salesroom in Charleston-on-Kanawha, W. Va., and will conduct business as consulting electrical engineers, contractors and dealers in electrical supplies. They will undertake electrical repairing of all kinds.

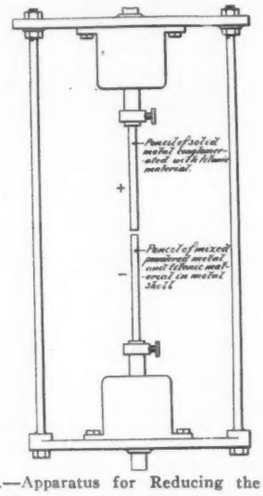
KENNEDY ELECTRIC COMPANY.—On March 7 the stock and good will of the Kennedy Electric Company, of Rochester, Minn., was purchased by Edwin M. Raetz from William Kennedy, who had conducted the business for the past five years. The present owner has been connected with the electrical trade in various branches for the past thirteen years, mostly in the contracting business, and was foreman for the Kennedy company during the past five years. The company is at present interested in equipping farm residences and buildings with electric-lighting plants to replace acetylene plants, in which it is meeting with much success. The business will continue under the same name which has been used since it was established, which was twenty-five years ago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 12, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,019,757. CONTROLLER FOR ELECTRIC MOTORS; V. E. Chamberlin, Indianapolis, Ind. App. filed Nov. 23, 1908. Has reverse and locking levers. For motor cars, etc.


Pencil of fused metal compounded with filmic material.
Pencil of mixed powdered metal and filmic material in metal shell

1,019,901.—Apparatus for Reducing the Arc Light.

1,019,764. TROLLEY-WIRE-SUPPORTING DEVICE; G. W. Cravens, Chicago, Ill. App. filed Sept. 28, 1908. Suspension clamp.

1,019,774. TROLLEY RETAINER. A. H. Fletcher, New York, N. Y. App. filed Oct. 8, 1910. The wheel is carried by a hinged arm, spring-pressed.

1,019,781. SIGNALING SYSTEM; E. R. Gill, Yonkers, N. Y. App. filed March 13, 1909. Train-dispatching system for telephone circuits.

1,019,848. TROLLEY; P. J. A. Schnoor, Holstein, Ia. App. filed Sept. 18, 1911. Hinged harp.

1,019,879. TELEPHONE METERING SYSTEM; G. Babcock, Rochester, N. Y. App. filed June 6, 1910. Registering apparatus at central and at the subscriber's station.

1,019,883. TELEGRAPH TRANSMITTER; J. A. Cox and H. Kidwell, Parkersburg, W. Va. App. filed Sept. 27, 1910. Adjustable contact point

1,019,901. APPARATUS FOR REDUCING THE ARC LIGHT; I. Ladoff, Cleveland, Ohio. App. filed June 17, 1908. The electrodes contain titanium oxide.

1,019,902. ELECTRICAL CONDUCTOR FOR LIGHTING PURPOSES; I. Ladoff, Cleveland, Ohio. App. filed Jan. 4, 1904. A flaming arc-light electrode containing silica and iron.

1,019,969. ELECTROLYSIS OF METALLIC SOLUTIONS; F. Lacroix, Paris, France. App. filed Feb. 19, 1910. Rotating cathode and a concentric anode.

1,019,970. ELECTRICAL CONDUCTOR FOR LIGHTING PURPOSES; I. Ladoff, Cleveland, Ohio. App. filed Dec. 2, 1903. A flaming-arc electrode of titanium oxide and a metal.

1,019,992. TELEPHONE SYSTEM; J. L. Rue and C. F. Brown, Coshocton, Ohio. App. filed Feb. 11, 1909. Cord and trunking circuit of manual systems.

1,020,001. ELECTRIC WATER PURIFIER AND FILTER; A. H. Van Pelt, Los Angeles, Cal. App. filed Aug. 9, 1911. For attachment to an incandescent-lamp socket.

1,020,016. ELECTRIC DELIVERY SYSTEM; J. Bailey, Great Falls, Mont. App. filed March 22, 1910. Switch-actuating mechanism.

1,020,025. DISTRIBUTION OF ELECTROMOTIVE POWER; H. Chitty, F. M. T. Lange and G. W. Mascord, London and Barnes, England. App. filed Aug. 26, 1907. Reversible field generator of the shunt-wound self-exciting type.

1,020,030. TOY; G. S. Elliott, San Marcial, N. M. App. filed June 20, 1911. Electromagnetically operated pendulum.

1,020,032. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Pittsburgh, Pa. App. filed July 27, 1903. Antenna of magnetic wires.

1,020,035. LINING FASTENING FOR ELECTRICAL LAMP SOCKETS; E. H. Freeman, Trenton, N. J. App. filed July 22, 1909. Fiber lining pressed into the cap.

1,020,036. INSULATING LINING FOR ELECTRICAL LAMP SOCKETS; E. H. Freeman, Trenton, N. J. App. filed June 21, 1911. Fiber lining molded in the cap.

1,020,056. COMPOSITE SHEET-METAL WORK; A. F. Rietzel, Stonington, Conn. App. filed April 14, 1908. Spot welding.

1,020,074. FIRE ALARM; T. Bell and E. Brophy, Fall River, Mass., and Tiverton, R. I. App. filed July 3, 1911. Automatic bell alarm.

1,020,080. CONTROL MECHANISM FOR ELECTRIC VEHICLES; C. E. Cochran, Cleveland, Ohio. App. filed July 28, 1911. Common control for a number of switches.

1,020,109. ELECTRICALLY OPERATED VACUUM TUBE; D. McF. Moore, Newark, N. J. App. filed Sept. 2, 1903. Contains the product of the electrolysis of aldehyde of anise.

1,020,110. TERMINAL FOR GAS AND VAPOR ELECTRIC APPARATUS; D. McF. Moore, Newark, N. J. App. filed Dec. 26, 1906. Spaced tubular electrode.

1,020,122. ELECTRICAL INSULATOR; D. G. Bolton (deceased), Camden, N. J. App. filed May 28, 1910. The conductor is sealed in a tube carried by one side of insulator.

1,020,123. CONDUIT FITTING FOR ELECTRICAL AND OTHER PURPOSES; A. Brampton and F. Osborne, Four Oaks, England. App. filed April 9, 1910. Split branch box of sheet metal.

1,020,143. MAGNET FRAME FOR ELECTRIC-IGNITION MACHINES; G. Honold, Stuttgart, Germany. App. filed May 17, 1910. The ends of the steel magnet form the poles of the frame.

1,020,149. ELECTROLYTIC SEPARATOR AND PROCESS FOR MAKING THE SAME; F. Marino, London, England. App. filed Dec. 24, 1910. Fibrous material coated with silica, gutta percha and paraffin wax.

1,020,155. ELECTRIC AUTO-MUSICAL INSTRUMENT; T. E. R. Phillips, Liverpool, England. App. filed Oct. 21, 1908. Piano, etc., electromagnetically operated keys.

1,020,172. TROLLEY HEAD; H. J. Woolsey, Jackson, Mich. App. filed Sept. 8, 1911. Pivoted and spring-pressed.

1,020,185. CONTROLLING SYSTEM FOR AUTOMATIC SWITCHING APPARATUS; A. M. Bullard (deceased) and J. N. Reynolds, New York, N. Y. App. filed April 1, 1910. Semi-automatic telephone selector.

1,020,193. REVERSING MECHANISM; T. J. Dalton, Chicago, Ill. App. filed Sept. 7, 1911. Street-car advertising device, etc.

1,020,211. AUTOMATIC TELEPHONE EXCHANGE; G. W. Lorimer, Piqua, Ohio. App. filed April 24, 1907. To prevent interference by a trouble line.

1,020,231. ELECTRIC SNAP-SWITCH; W. Van P. Steiger, Bridgeport, Conn. App. filed Dec. 3, 1908. Rotary type, for key sockets, etc.

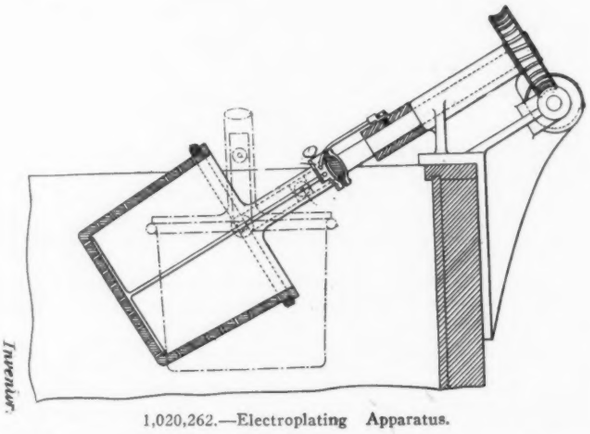
1,020,238. TRACK INSTRUMENT; E. C. Weir and H. F. Tansey, Dayton, Ohio. App. filed Jan. 9, 1908. Grade-crossing alarm.

1,020,245. ELECTRIC LAMP SOCKET; W. Abbe, Brooklyn, N. Y. App. filed June 9, 1911. Quadruple break.

1,020,249. SAFETY FUSE; I. E. Barricklow, Antioch, Cal. App. filed July 18, 1911. Cartridge type.

1,020,262. ELECTROPLATING APPARATUS; T. R. Canning, Birmingham, England. App. filed Feb. 23, 1911. Rotatable receptacle for plating small articles without wires.

1,020,319. INCANDESCENT ELECTRIC LAMP; R. H. Singley, Burnham, Pa. App. filed Nov. 18, 1911. Multiple filament support.



1,020,262.—Electroplating Apparatus.

1,020,323. ELECTRIC LIGHTING; C P. Steinmetz, Schenectady, N. Y. App. filed April 25, 1900. Starting device for vapor-electric lamp.

1,020,330. DEVICE FOR PREVENTING COLLISIONS AT SEA; D. H. Taylor, Palisades, Col. App. filed June 3, 1910. Flexible outlying conduit.

1,020,378. DRUM HEATER; C. B. Wanamaker, Indianapolis, Ind. App. filed May 11, 1911. To prevent condensation inside of a musical drum.